Marine Engineering

Vol. 7. NEW YORK, APRIL, 1902. No. 4

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REPAIRS AND ALTERATIONS TO THE U. S. S. OLYMPIA.

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Among the vessels recently fitted out at the Boston Navy Yard, is the first class protected cruiser *Olympia*, made famous as the flagship of Admiral Dewey in the battle of Manila Bay.

It is interesting to note the rapid strides in the art of shipbuilding, not only as affects the under-water and above-water form of a vessel, the water-tight subdivision, the layout and disposition of armor, armament, machinery, coal and stores, but more especially as concerns the remaining features that go to complete the vessel and make the most of the space allotted for each particular purpose aboard ship. After the *design* of a vessel, in its primary sense, is determined and the ship, as a floating body, is built, with its enormous watertight subdivisions, and its armor and guns are decided upon, its engines, boilers and propellers installed, there still remain numberless details, large and small, upon which depend, both directly and indirectly, the efficiency of the vessel as a fighting machine. In fact, it may be said that the ultimate efficiency depends much more upon these details than upon the first layout of the design, however necessary the latter is as a foundation. It is particularly in the matter of these many details, which may be summarized as interior fittings, that rapid improvement and changes in warship construction are being effected at the present time. During the past decade, the principal sea powers have been building warships, all of which, class for class, resemble each other on paper; that is, so far as concerns their principal dimensions, their water-tight subdivisions, their disposition of armor, guns and machinery. But a visit aboard the various vessels built ten or even five years apart, or even on vessels built by different nations at the same period, reveals a very apparent dif-

UNITED STATES PROTECTED CRUISER OLYMPIA.

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ference; this difference can even be noticed among so called "sister ships," when built at different yards. In the building and fitting of vessels of the United States Navy, it is only by the exercise of extreme care on the part of central authorities at the Navy Department, as well as of the Department's local representatives, that anything like homogeneity and standardization in the large field of interior fittings is approached. The generally accepted definition of efficiency is connected with the idea of maximum output with minimum input; but when this word is applied to a man-of-war, and particularly to the individual parts, the word should in addition carry the idea of *certainty of operation when called upon to perform the functions for which it was designed.* Thus the care that a device will receive, the intelligence of the operator, and its accessibility to receive frequent overhauling and inspection, are features that should receive great consideration in the installation of fittings in a vessel.

It is quite right that in the primary design of a warship the offensive and defensive features should be solely considered, the battery being so laid out that the maximum amount of destructive gunfire can be concentrated against the enemy in any direction, the armor and water-tight bulkheads so disposed that the maximum protection is secured, and the propelling machinery and fuel being such that the maximum speed and radius of action compatible are obtained. But, when these primary fighting qualities are settled, it is of the utmost importance that the officers and crew that are to be housed in the small remaining space available be made as comfortable as possible, so as to be in fit condition to get the best results out of the machines they handle. Considering the men merely as *machines*, it is of as much importance that they be kept in mental and physical health as it is that any *other* machinery aboard ship be kept in repair and working order. Therefore, if we are to build warships that excel those of foreign powers, it must be by providing the best weapons and ensuring that the personnel that are to handle them be kept in fitness for the best results. In the necessarily cramped quarters that the officers and men are provided with, it would be a short-sighted policy to provide other than the most comfortable environments, when efficiency is not otherwise involved. It is a notable fact that more attention is paid in the United States Naval service to the comfort of all hands than in the service of any other nation, not even England excepted.

In view of the importance of the fittings of a vessel, it is not surprising that changes in this direction should be both rapid and at times radical, and that standardization should be a difficult matter except in minor details. In reference to the *Olympia* the question may be asked, Why should a steel vessel of this type, which was only completed in '95, and which was evidently quite fit for battle in '98, be laid up for extensive repairs? The answer is, In order that the internal fittings and auxiliaries above referred to, on which the fighting efficiency so largely depends, may be put in thorough repair and modernized. The importance and extent of this work can hardly be realized without actually following its progress through the various stages; the absolute interdependence of fittings upon each other in cramped and crowded spaces is such that the disturbance of one fitting generally causes far-reaching results in connection with its neighbors. These results can be anticipated only after careful experience in such work.

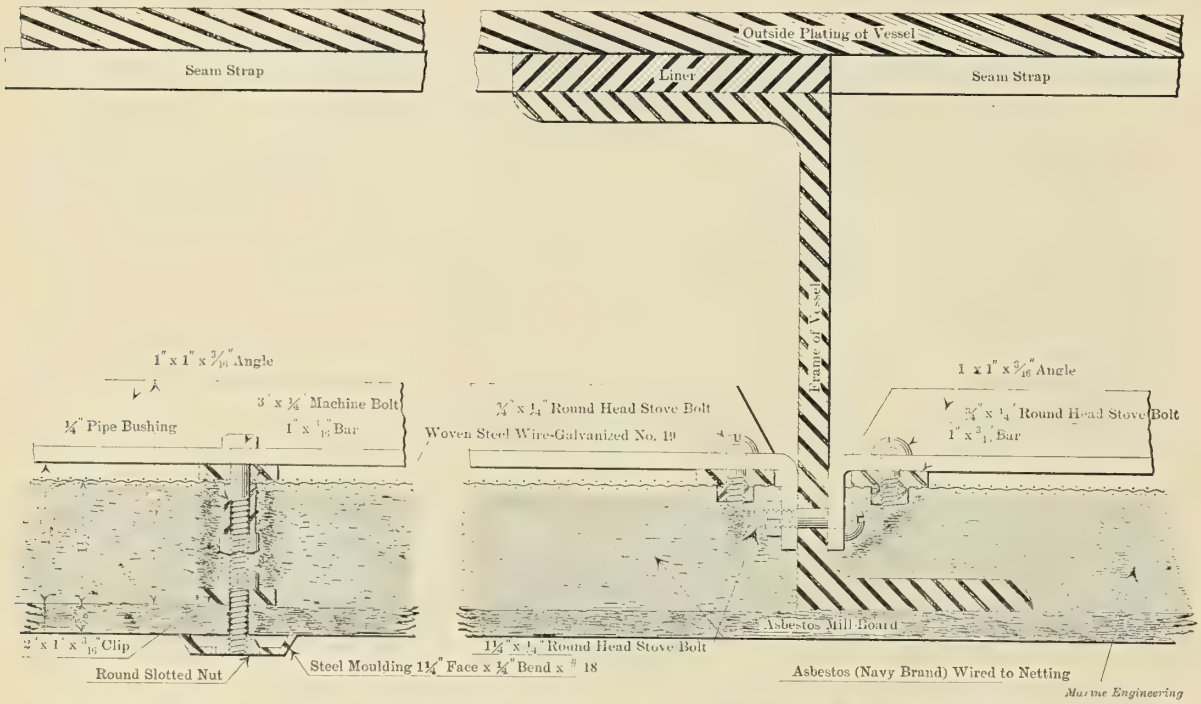

Seam Strap
Outside Plating of Vessel
Liner
Seam Strap
Frame of Vessel
1" x 1" x 3/16" Angle
3/4" x 1/4" Machine Bolt
1/4" Pipe Bushing
1" x 1/2" Bar
3/4" x 1/4" Round Head Stove Bolt
Woven Steel Wire-Galvanized No. 19
1 x 1" x 3/16" Angle
3/4" x 1/4" Round Head Stove Bolt
1" x 3/4" Bar
Asbestos Mill Board
2" x 1" x 1/16" Clip
Round Slotted Nut
Steel Moulding 1 1/4" Face x 1/4" Bend x # 18
1 1/4" x 1/4" Round Head Stove Bolt
Asbestos (Navy Brand) Wired to Netting
Marine Engineering

FIG. 2. METHOD OF FITTING ASBESTOS SHEATHING AGAINST THE SIDES OF THE VESSEL IN OFFICERS' QUARTERS.

The *Olympia* was built by the Union Iron Works, San Francisco, and was first commissioned in February, 1895. She is officially known as a "protected cruiser;" she carries four 8-inch breech loading rifles in barbette turrets, the barbettes being 4½ inches thick (Harveyized steel); there are also ten 5-inch rapid fire guns, mounted in sponsons (4 inches thick) on the gun deck, and fourteen six pounders in sponsons (2 inches thick) on the berth and superstructure decks; also six one pounders, one Colt's automatic, and one Gatling on the superstructure and in military tops. The protective features of the vessel include an armored conning tower, also a protective deck 4 3-4 inches thick on the slopes and 2 inches on the flat. The waterline is protected by a cofferdam, packed with fireproof cornpith cellulose; the coal bunkers furnish, also, a further protection at the waterline.

The *Olympia's* principal dimensions are as follows:—

Length, load waterline	340	ft. 0 in.
Breadth, extreme	53	" 5⅝ "
Normal Draft, forward	20	" 6 "
Normal Draft, aft	23	" 6 "
Normal Displacement	6 050	tons
Full load Displacement	6,800	"

She has cylindrical boilers, with vertical triple expansion engines, operating twin propellers. She carries 1,153 tons of coal, and has a steaming radius of about 6,000 miles. Her complement as a flagship is 34 officers, 412 crew and 40 marines.

Some of the more important items of work in connection with the recent refitting of the *Olympia* are given below. It is interesting to note the bearing, either direct or indirect, of each of these items on the ultimate qualities of the ship as a weapon—a fighting machine, self-contained, resourceful and always ready for any call that may be made upon its services in any climate, and at any distance from its base of supply.

The vessel was stripped of all furniture and of all sheathing against the bulkheads and inner surfaces of the ship so as to allow the entire steel hull, both inside and outside, to be scaled, the thick accumulation of paint being removed, together with any rust that existed. New paint was then applied to these surfaces.

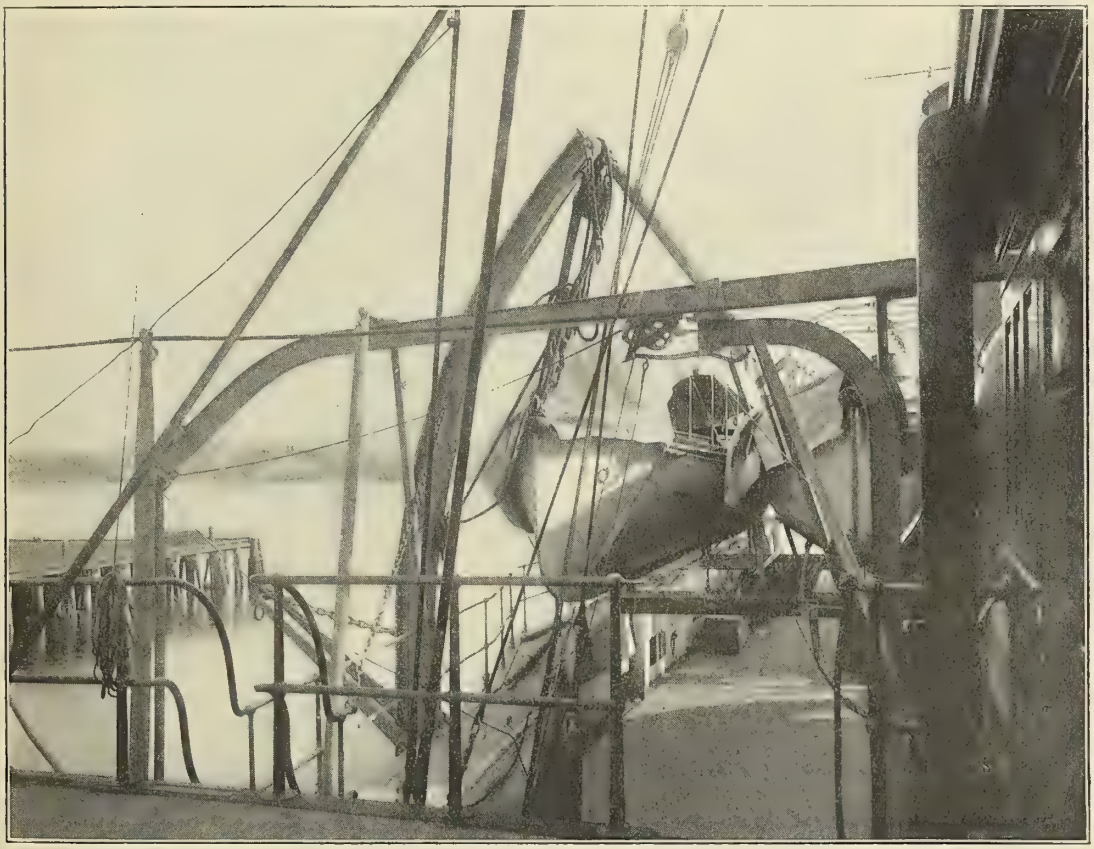


FIG. 3. SPECIAL COAL HANDLING TROLLEY.

The magazines and storerooms were resheathed with wood battens after certain of their bulkheads were altered to provide an improved arrangement and stowage of ammunition.

All of the six above-water torpedo tubes were removed, and their openings through the sides of the vessel closed; the spaces formerly occupied by these tubes are now utilized as additional crew space and storerooms.

The turret tubes or columns, by means of which the turrets are turned, and through which the ammunition is hoisted to the turrets, formerly extended only to the platform deck, and all of the ammunition had to be placed in the hoist at this deck. These tubes have now been extended down to the hold, where all of the eight-inch ammunition is located, and suitable trol-

leys are provided for bringing this ammunition to the hoist entrance. The hoists in these turrets have been entirely remodeled. As fitted formerly there was an electric motor located in the after end of the turret, operating a single ammunition car by means of a wire rope; this rope led over sheaves on a crane which pivoted so that the sheave, from which the car suspended, could be swung directly over the loading position of either gun. All of this mechanism was removed. The new hoist consists of two cars, one on each end of a wire rope which leads over sheaves in the top of the turret and around a drum which is geared to an electric motor located in the port side of the turret. As one car is hoisted the other lowers. The car is arranged with a stop at the upper end of the ammunition tube, and abaft this upper position of the car is a table on which the shell is drawn from the car and pivoted to the loading position.

One of the most important of all the changes on this vessel is the introduction of electric power for turning the turrets. They were formerly turned by steam, but the use of electricity, for this purpose, having proved so eminently successful on the *Kearsarge* and *Kentucky*, its introduction on the *Olympia* was by no means an experiment. The delicacy of train, as well as the rapidity and certainty of action, which can be obtained with electricity, make it the favorite power for this as well as for many other uses on board warships.

Each turret is provided with two motors of 20 K. W. each, each motor being directly connected to a worm shaft; these worms work in a gear which is secured to the central tube or column of the turret, the two worm shafts being cross connected by means of bevel gears to ensure that the two worms always operate to produce identical results. The specifications for the electric installation of these turrets require nine different speeds at which they can be operated, the fastest being at least 6½ degrees per second for the rotation of the turrets. There is provided a tripping device for automatically bringing the controller to the *off* position so as to stop the turret at its position of extreme train on either side. The great delicacy of train, obtained by the use of these motors, renders the guns carried in the turrets much more effective weapons than they were formerly. Effective gunfire being the primary object of a warship, the value of a mechanism for delicate and accurate training of the guns cannot be overrated.

In refitting this vessel much care has been used to ensure that the living spaces be made habitable in all latitudes. The sides of the old wooden war vessels, in many instances, consisted of several feet of thickness of solid oak, thus forming an excellent protection inside against extremes of heat and cold occurring outside. In modern warships, however, the steel hull is only a fraction of an inch in thickness, and while it excludes water it does not prevent rapid changes of temperature in accordance with the temperature outside. These changes also cause "sweating" to take place inside the vessel, the effect being unhealthy and otherwise unpleasant quarters for living. For many years a sheathing of wood has been applied to the inner surface of the frame angles in officers' quarters, thus creating an air space of several inches in thickness. Similar results were obtained in crew-spaces, pantries, etc., by the use of thin sheet iron to form the sheathing, although the nonconducting properties of the combined air space and sheathing are not so great in the latter case as with the use of wood sheathing. In refitting certain ships of our Navy, and in the construction of certain new vessels, asbestos lining has been largely used for sheathing the sides of living spaces. The results have been very satisfactory, a more even temperature being maintained in this way than by any of the former methods. Apart from the nonconducting properties of asbestos, it commends itself for use on warships on account of its fireproof and nonsplintering qualities.

In the case of the *Olympia* asbestos has been used in the officers' living spaces, and its use has also been extended to certain other spaces where it is particularly applicable; notably in the engine and boiler room trunks, and on the under side of the beams that support the deck of the dynamo room, magazines being located under this room. All sides of the midship magazine were also sheathed with asbestos, and the air space thus provided was fitted with special supply and exhaust pipes connected with the ventilating blowers to ensure a frequent change of air and consequent reduced temperature.

The method of fitting this asbestos sheathing against the sides of vessels is shown by reference to Fig. 2. A background, consisting of a wire netting, is secured to a framework of small angles. On this netting are fitted sheets of asbestos firefelt, 1½ inches in thickness, being held against the screen by means of washers secured to the netting by wire. Against this surface of asbestos firefelt are fitted sheets of asbestos millboard, 5-8 inch in thickness, the seams of which are covered with strips of steel moulding, the latter being secured by means of bolts previously fitted in place through the small angles forming the framework. The nuts on these bolts are countersunk and rounded, and the sheathing, thus finished, presents a neat appearance of panelwork.

In fitting this sheathing in other than living spaces, the millboard is omitted and its place supplied by galvanized sheet iron, through bolts with common nuts being used to secure the sheets to the angle iron structure. This method is simpler, and less expensive, than that used in the living quarters.

The cruising powers of a vessel at any time being so largely dependent on the amount of coal to be found in her bunkers, and her maximum speed being dependent on the rapidity and ease with which this coal can be transported to the firerooms, it is necessary that the best possible arrangements be provided for rapidly getting the coal aboard and in the bunkers, whether from a collier at sea or from a lighter or wharf alongside. The bunkers being subdivided into many compartments (for safety in case the hull is perforated in action), the rapid transportation of coal from the more distant compartments to the firerooms becomes a problem worthy of careful consideration. In the *Olympia* an overhead trolley has been run in the wing passage on each side, the length of the upper

bunkers. By this means coal from any upper bunker can be rapidly carried to the scuttle over any lower bunker on the same side of the vessel, and thus to any fireroom.

In coaling the ship formerly, all coal had to be placed aboard through hinged chutes or "cheese ports" through the sides of the vessel. The rapidity of coaling has been largely increased during the present refitting by the installing of four special coal trolleys, located above the superstructure deck and arranged for coaling over all. One of these trolleys is illustrated in Fig. 3. Each trolley carriage runs on an I beam whose inner end is located near the center line of the ship, and whose outer end is well rounded down and extends about five feet over the side of the vessel when rigged out. Near the outer end of this beam it is supported by means of a large A frame, through which this trolley carriage and the bags of coal are required to pass. The lower ends of the stanchions which form this A frame are hinged, so

FIG. 4. BOW VIEW OF U. S. S. OLYMPIA SHOWING COAL HANDLING TROLLEY IN USE.

that the entire beam can be rigged in and carried with its end clear of the ship's side when not in use. In coaling ship with these trolleys the coal bag is hoisted by means of a wire pennant, whose inboard end is secured to a loose drum on a winch. This drum is thrown in gear by a friction coupling, and when the bag is raised and run in to its proper position, over the large square hatches, it is lowered by means of a friction band operated by a foot lever. These hatches, one set under the lowering position of each trolley, extend through the superstructure and gun decks, and the bags of coal, as they are lowered, land on trucks and are thus transported to the various coal scuttles over the bunkers. The winches are continuous in motion, not being reversed while used for getting in and lowering coal, the lowering being operated entirely by gravity and controlled by friction. The cheese ports can be used for coaling through the sides at the same time that the trolleys hoist coal over all.

These trolleys have been found to give good satisfaction, having been used in the first coaling of the vessel as she fitted out. The working of the trolleys can be further studied by a reference to Fig. 4, in which one of them is shown in the act of hoisting a bag of coal.

The deck winches referred to above are new, none having been provided with the ship's first outfit. They are two in number, each being provided with a gypsy on each end for hoisting boats and other weights, and each winch also having two loose drums (above mentioned) for use in hoisting coal. The winches are on the superstructure deck, and their shafts, as usual, extend athwartship. Each winch will alone hoist the heaviest boat carried on this vessel (33 foot steam launch). Thus installed they have proved very satisfactory.

The artificial ventilation system of the ship has been entirely remodeled in accordance with modern practice, and it is now much more efficient than formerly. The system formerly consisted of two large steam driven blowers, located in the after end of the crew space on the berth deck. The piping and trunks used for distributing the fresh air throughout the ship were necessarily very great in length and large in area in order to allow the necessary volume of air. This required many large openings throughout water-tight bulkheads and decks, reducing the effective watertightness of such compartments. The great lengths of piping traversed by the air, together with the many turns and other obstructions in the same, were also such as to cause great loss of velocity and reduced efficiency. In recent vessels of our Navy it has been the practice to use a large number of blowers in ventilating the various compartments. By this means a small group of compartments is ventilated by means of a blower centrally located with reference to that group; the leads of pipes are short, the pipes themselves are small, and no large openings need be cut in bulkheads. The use of automatic valves where bulkheads are pierced is almost, if not entirely, eliminated. The blowers being run by electricity, the objectionable features incident to engines and steam piping in crew spaces, passages, etc., are also eliminated. The *Olympia* now has nine electrically driven blowers, as follows:—

Two in the dynamo room to supply fresh air to that room, and to the magazines under the same.

Two on the platform deck, over the dynamo room, to exhaust foul air from the dynamo room and from the various compartments on the forward berth deck, forward platform deck and the storerooms forward.

Two on the after berth deck to supply fresh air to the main crew space, to the junior officers' and warrant officers' quarters, and to the various pantries, closets, bath rooms, washrooms, etc., on the berth deck as far aft as the wardroom messroom; the distiller room, funnel rooms and midship magazine are also supplied with fresh air by these blowers.

Two on the after platform deck to supply fresh air to the wardroom, staterooms, bathrooms, etc., also to the after storerooms, magazines, tiller room, and other compartments under the wardroom.

One blower is located under the after end of the dynamo room, and exhausts hot and foul air from the forward magazines, special exhaust ventilation being necessary for these magazines, on account of their proximity to the firerooms and the dynamo room.

In addition to these blowers, the ventilation of the *Olympia* has been further improved by the introduction of additional trunks and cowls for the supply of fresh and the exhaust of foul air. The firerooms are provided with special steam blowers for ventilation and for forced draft; the engine rooms have special trunks with cowls for supplying fresh air, the hot air being exhausted through the main engine room hatches and through other trunks provided for the purpose.

The coal bunkers are supplied with fresh air through trunks that end at the hammock berthing on each side of the superstructure, these trunks having branches that lead to the various bunkers. The hot air from the bunkers is exhausted through other systems of piping which combine in trunks that lead up through the main funnel hatch.

The firemain has been practically renewed as well as much extended; a new feeder main has been run under the protective deck, which forms, with the main under the upper deck, two principal lines of feeders. These mains are connected together at suitable intervals by risers, and are supplied by two main fire pumps, one in each engine room outboard adjacent to a seacock. They can also be supplied by each of the four auxiliary fire and feed pumps in the boiler rooms, and also by the three hand deck pumps. Gate valves are fitted at suitable intervals in the firemain piping so as to enable such portions as may be injured in battle to be shut off and the remainder utilized. The firemain system is fitted with 30 connections for fire hose. The firemain is also connected with the distilling plant and with the flushing main.

The firemain and all of its risers and branches are of heavy copper pipe, having a coating of black Sabin enamel inside. This enamel has recently been used, with good results, in the case of pipes that are to be continually or periodically flooded with salt water. Iron or steel pipes, unprotected, are found to deteriorate rapidly by corrosion and galvanic action

when used for salt water service. For this reason copper piping has generally been used for firemain service aboard ship, it being of the utmost importance that the piping be always serviceable and capable of withstanding considerable pressure. However, under service conditions, copper pipes, unprotected inside, will deteriorate in time, and some cases of rapid wasting have recently been noticed. The use of enamel in this connection is expected to lengthen greatly the life of the firemains. Asphaltum has also been used with good results in similar cases, although not on this vessel.

The fresh water piping system in this vessel has been entirely renewed and remodeled to suit the somewhat altered conditions of the quarters, pantries, etc. Fresh water service has been provided in each stateroom, automatic closing valves being provided over each wash bowl. All the fresh water piping and fittings are of iron, tin-lined inside, except the smallest service pipes, which are of brass.

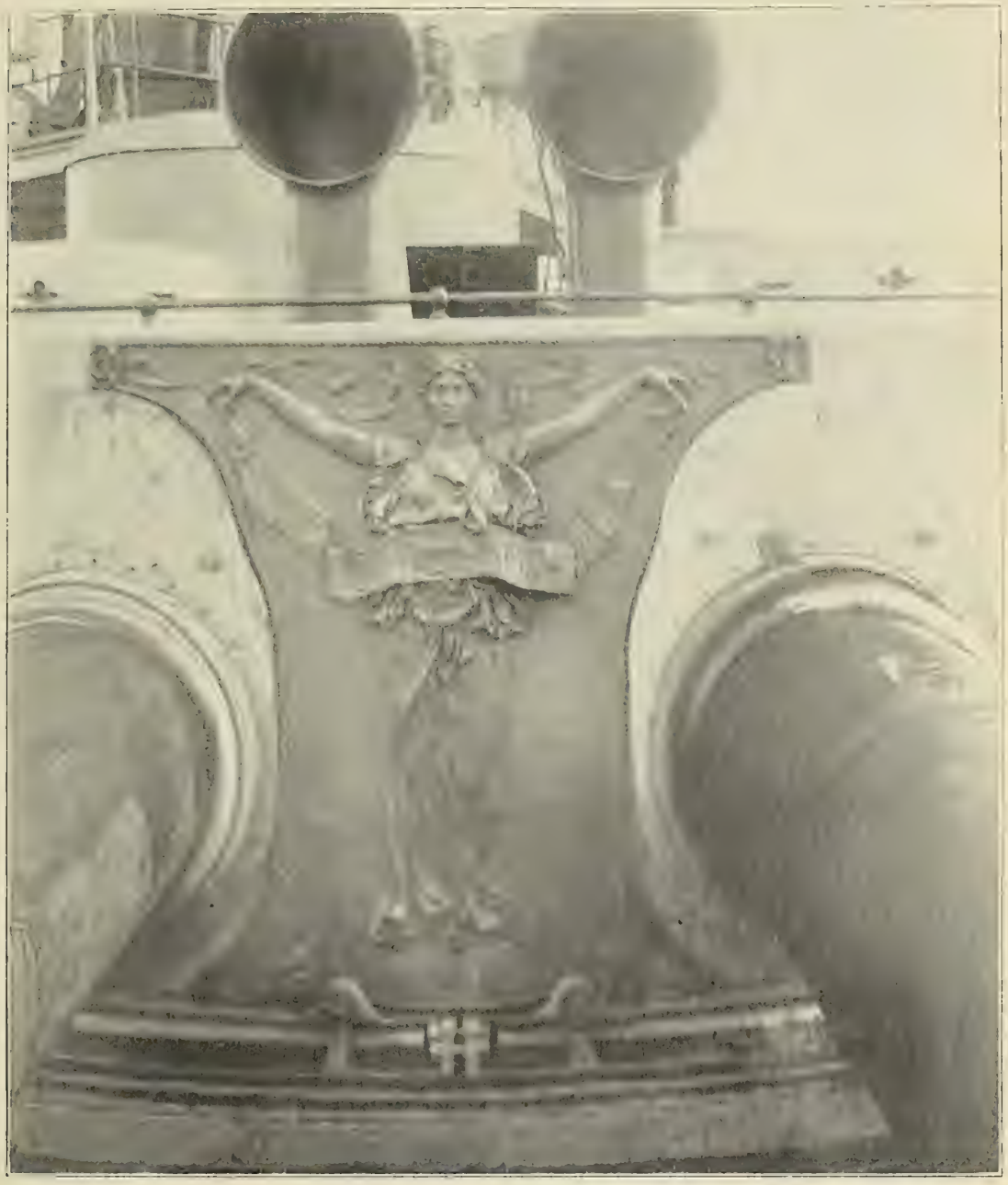


FIG. 5. PLATE PRESENTED TO THE U. S. S. OLYMPIA TO COMMEMORATE THE BATTLE OF MANILA BAY.

The flushing system is of iron, lead-lined inside; all drains from baths, closets, sinks, etc., are of brass. The piping used for fresh water and salt water services is designed to combine the best possible service with long life to the material. All of the plumbing is new. The secondary drains and piping in connection there-

with are also new, being of extra heavy steel pipes galvanized.

Many of the speaking tubes have been renewed, and the service greatly extended.

The standard compass platform, which formerly occupied so prominent a position, high in air, over the conning tower, has been removed, and a new platform built immediately forward of the after bridge and connecting with it. The platform of this bridge is insulated from the brass stanchions supporting it, and the hand railing and its stanchions in the vicinity of the platfrom are of wood, care being thus taken to guard against stray currents which might affect the compass.

tilling plant has been materially enlarged, also an auxiliary condenser has been provided in the dynamo room for the use of the generator engines. Considerable new steam piping was necessitated in connection with the installation of the increased electric plant.

The total rated output of the *Olympia's* generators, on her previous cruise, was 64 K. W. (four generators of 16 K. W. each). This has been increased to 176 K. W. (four generators of 32 K. W. each, and two of 24 K. W. each). These generators are all in one compartment under the protective deck, being grouped three on each side, the forward turret column with its motors and gearing for turning, being located in the middle of this compartment. The in-

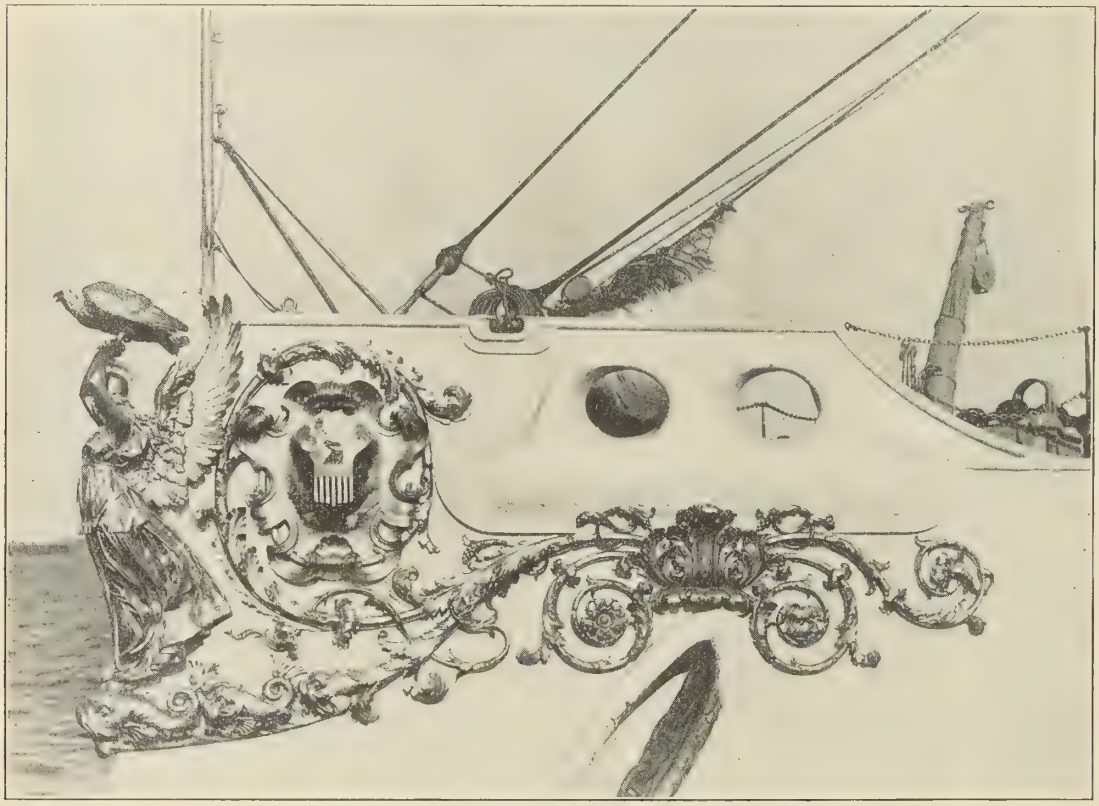


FIG. 6. BOW ORNAMENT WITH SEAL OF THE UNITED STATES.

An additional signal house has been built abaft the after bridge and on a level with it; this house is designed for the use of the commander-in-chief when sailing in squadron; it is fitted with wide transoms which can be used as berths, and is also fitted as an office. This signal house is in a prominent position, and is sufficiently large (about 12x14 feet) to affect the appearance of the vessel. The mainmast being immediately adjacent to this house, it was necessary to remove the lower top, which was formerly used as a searchlight platform.

The alterations in the engineering department have been comparatively few. All parts of the boilers and engines, including all auxiliaries, also all piping, valves, shafting and shaft bearings, have been carefully overhauled and repaired, so that the entire steam plant is in thoroughly first-class condition. The dis-

creased electric power for this vessel is required principally for the turning of turrets, and for the nine electric blowers, the ship being formerly (as at present) provided with electric hoists for ammunition and with electric lighting and searchlights.

A complete system of battle order and range transmitters, indicators, fire alarms and thermostats has also been installed.

Most of the feeders carrying electric current are located below the protective deck, and are run in iron conduits insulated inside. This insures greater protection than by any other means in common use.

All of the cofferdams were emptied of the cocoa fibre cellulose and refitted with fireproof cornpith cellulose, after the compartments were thoroughly scaled and painted.

In refitting the staterooms, offices and messrooms,

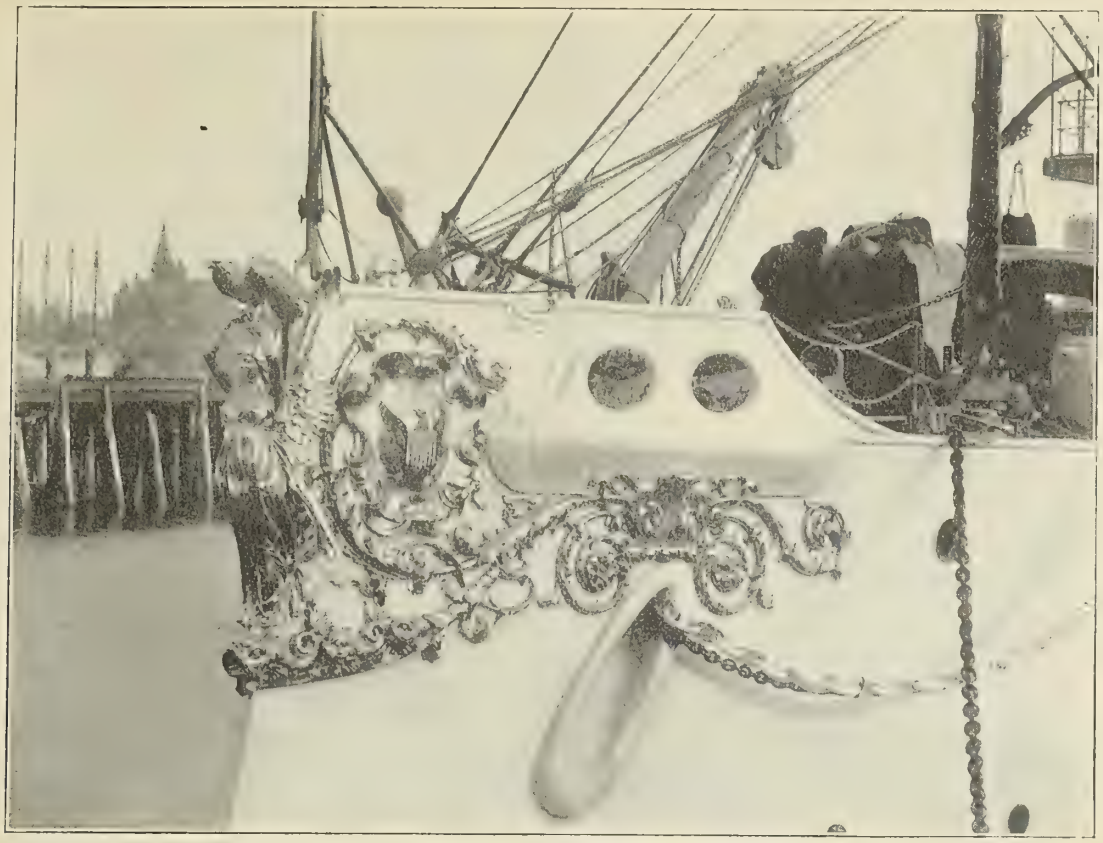


FIG. 7. ANOTHER VIEW OF BOW ORNAMENT.

FIG. 8. STERN ORNAMENT, U. S. S. OLYMPIA.

it was found necessary to make certain changes to provide for the altered complement of officers. Fewer junior officers and more warrant officers are now carried on vessels of this class than formerly. It was necessary to provide suitable messroom, pantry and staterooms for the warrant officers, provision being made for eight. In refitting the quarters, corrugated sheet iron bulkheads athwarship were used between staterooms in place of the wooden bulkheads formerly used. The wood bulkheads fore and aft, inboard of the staterooms, were fitted to button in place, so as to be portable; by this means these wooden bulkheads can be readily removed in case of war, and their places supplied by canvas screens; these, with the iron athwartship partitions, will present much better fireproof qualities than were possessed formerly.

In refitting a vessel of such historic interest as the *Olympia*, it was thought appropriate to perpetuate the memory of her good work by incorporating into the hull of the vessel figures and lettering of more than usual ornamentation. The vessel is accordingly fitted with the following:—

On the forward side of the after bridge are secured two plates inscribed in plain lettering, easily read the length of the deck, "Manila Bay, May 1, 1898."

On the forward turret between the two gunports is a bronze tablet bearing the historic words, "Gridley, you may fire when ready." This tablet was presented to the ship by the City of Olympia and the State of Washington. A photograph is reproduced in Fig. 5.

The *Olympia* is fitted with bow and stern ornaments more elaborate in design and workmanship, and more striking in effect, than those on any modern vessel in our Navy. The bows of modern warships have generally been ornamented with a simple shield secured to the stem and curved on either side to follow the lines of the bow. In the case of the refitting of the *Cincinnati* (at the New York Yard) and the *Olympia* (at the Boston Yard) there has been a tendency to return to the practice in vogue in the days of wooden shipbuilding, when figureheads were such in more than name. The December, 1901, number of Marine Engineering contained reproductions of photographs of the bow and stern ornaments of the *Cincinnati*. Figs. 6, 7 and 8 give corresponding photographs of the *Olympia's* ornaments. These differ from the *Cincinnati's* only slightly in general design, the seal of the United States being used on the *Olympia* where the seal of the Navy Department is to be found on the smaller cruiser. The *Cincinnati's* ornaments were part of bronze and part of wood, whereas the *Olympia's* are of bronze throughout, the eagle at the bow being cast entirely from metal which formed a part of the operating gear of the torpedo tubes carried on the vessel during the battle of Manila Bay, the other parts of the bow and stern ornaments containing a portion of similar historic metal. The bold lines of the winged figure of victory, wearing the helmet and breastplate of Minerva, are well brought out in the photographs (Figs. 6 and 7). On the uplifted hands is poised the

FIG. 9. SILVER SERVICE PRESENTED TO THE U. S. S. OLYMPIA BY THE CITIZENS OF THE STATE OF WASHINGTON.

American eagle, about to fly. The Victory stands over a line of dolphins and seaweed, which trail aft and up in graceful lines, ending in acanthus leaves. The whole ornament is symbolic of American freedom, gained by prudence and courage, and suggests the prominent part taken by our infant navy in the victories that were the making of the nation. The entire ornament extends from the bow aft a distance of thirteen feet on each side. In order to prevent the possibility of the figure being chafed or otherwise damaged by the vessel's cable when riding at anchor, a hawse pipe was fitted below the ornament, the old hawse pipes being above, as can be seen in the photographs.

The stern ornament is less elaborate than that at the bow, but is very effective. Around the nameplate is graceful scrollwork, warping closely against the stern of the vessel. The top of this scrollwork folds into a large cartouche on which are mounted a spread eagle and the United States shield. Against the scrollwork on either side is a boyish figure, supporting the helmet of Mars. The foliage of acanthus is used with good effect in the stern ornament as well as in that at the bow. Fig. 8 gives a good view of the stern of this vessel.

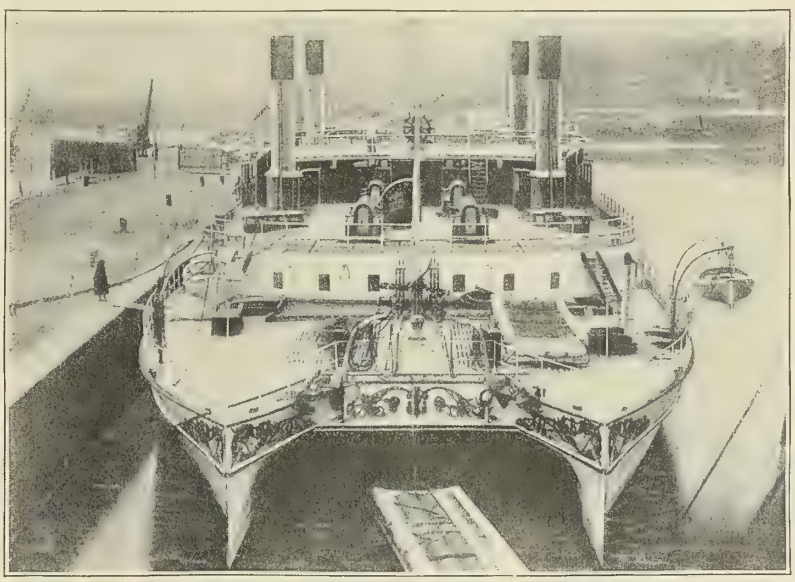
Fig. 9 is a photograph of the silver service, presented to the *Olympia* by citizens of the State of Washington, after her return from Asiatic waters. The cabinets in which this silver is stowed occupy prominent spaces in the Admiral's and Captain's cabins. The wood of which the cabinets are constructed formed a part of the ship before she was refitted.

American Schooners.—According to Mr. John S. Rand, of Portsmouth, N. H., there are 377 schooners of over 500 gross tons register owned on the Atlantic coast

An Old Channel Steamer.

An interesting steamer was built for the English Channel service in 1875 by the Thames Iron Works. At this time many proposed plans were suggested by naval architects, whereby the horrors of sea sickness in the hours of the Channel passage might be reduced, and the *Castalia*, as here illustrated, was actually built. As is seen, her hull is in halves, the same as if two longitudinal bulkheads were placed in a vessel, and the ship cut in two, fore and aft.

The dimensions of the *Castalia* were: Length, 290 feet; beam of each hull, 17 feet; designed draught 6 feet 6 inches. The two hulls were rigidly connected by a superstructure 168 feet long and 60 feet broad. Transverse stiffness was given by four engine and boiler room bulkheads, the continuation of these bulkheads above the hulls, holding in a large measure the two parts together.



OLD ENGLISH CHANNEL STEAMER.

The propelling power consisted of two pairs of direct acting diagonal engines, the cylinders being 46 inches diameter, 4 feet 6 inches stroke. The first set of boilers, owing to severe priming, was replaced by four boilers of 12 feet diameter. The designed indicated horse power was 1,250, which should have given the vessel a speed of 14 knots; but owing to the added weight of new boilers the draught was increased to 7 feet, thus increasing the already large skin resistance, so that on trial although 1,516 horse power was indicated a speed of only 11 knots was obtained.

The *Castalia* for a time attracted much attention and secured a large part of the passenger travel in the summers of 1876-'77. It is reported that she was a very steady ship, but her slow speed finally debarred her from this service.

The above facts, together with the illustration, are taken from *The Engineer*.

STEAMER SATURN OF THE GREAT LAKES.

RECENT OPERATIONS IN THE SHIPYARDS ON THE GREAT LAKES.

BY WALDON FAWCETT.

Many circumstances combine to make notable the record of steel ship building on the Great Lakes since the dawn of the century. Most important of these, perhaps, have been the new conditions growing out of the formation of the great industrial combination known as the United States Steel Corporation. The fact that this new giant of the industrial world controls a very large proportion of the iron ore transported by water from the Lake Superior district, and which really forms the backbone of lake traffic is of itself an important factor, but presumably farther reaching in its influence was the fact that the Steel Corporation from the date of its inception abandoned the policy of making constant additions to the ore-carrying fleet which had been followed very energetically by the principal component companies during the few years prior to the formation of the combination. However, contrary to general expectation, there has been no stagnation in the shipbuilding industry on the inland seas. The individual vessel owners, who were apparently to be driven from the field by the steady encroachments of the powerful producing interests, have taken heart, and the commissions which they have placed with vessel builders enabled the record of new construction during the first year of the new cycle to compare most favorably with that of any twelve month during the past decade.

At the opening of the year 1901 there were building or under contract at the shipyards on the Great Lakes a total of sixty-one vessels with an aggregate valuation of $12,535,000. With few exceptions all of these vessels were completed, delivered and went into commission during the past year, and during the closing six months of 1901 the fresh water shipbuilders commenced the construction of or contracted to build forty-five additional vessels, the contract price of which foots up $10,473,000. All of the tonnage represented in the latter figures is, of course, for delivery during the year 1902, and a large proportion of it will be completed during the first six months of the year.

The really phenomenal prosperity prevalent in Great Lake ship yards in the face of what would naturally be construed as unpropitious circumstances is the more marked by contrast with the comparative dulness in many establishments on the sea coasts, possibly in anticipation of the enactment of ship subsidy legislation. Indeed, so taxed has been the capacity of the inland yards for some months past that in December, 1901, it was impracticable to place in any prominent lake ship yard a contract for a steel ship of moderate size with any expectation of delivery before the autumn of 1902. Perhaps a proper perspective for the situation may be best obtained by a comparison with the conditions existent in previous years, and for this purpose it may be noted that on January 1, 1899, there were only twenty-six vessels of all kinds building on the Great Lakes, their aggregate valuation being $2,974,000, and at the opening of 1900 the thirty-seven vessels on the stocks or on the books of the ship builders, embracing among others the largest vessels ever turned out for inland navigation, represented a total outlay of $8,902,000.

In the above statistics there have been included all vessels of over one hundred tons, whether of wooden or steel construction, but that the metal hull is attaining on the Great Lakes to the same monopoly that it elsewhere enjoys is readily attested. Of the large fleet constructed during the year 1901 only six were of wood, and among the new or uncompleted contracts there can be found commissions for but two wooden vessels. Interesting as is this transition, there is manifest in the current chronicle of lake shipbuilding new tendencies far more revolutionary in influ-

ence than that just cited. Most prominent among these are the abandonment of the policy of constructing vessels of excessive size, and the inclination to dispense with the large tow barges which long constituted a distinctive feature of fresh water shipping.

The gradual growth in length of the lake cargo-carrier reached its culmination in the closing year of the century. Up to that time each successive year had witnessed an expansion in the dimensions of new vessels built for service on the inland seas, and it was freely predicted that this growth would continue along the course already followed in the case of the transatlantic liners. So general was this belief, even among the best informed men in the lake shipping field, that during the old century's final year there were constructed for one interest four vessels, each approximately 500 feet in length, and not less than eight other prominent firms had built a total of seventeen vessels, every one of which was over 400 feet in length, and ten of which were each 450 feet or over. A sudden realization, however, that there are limitations in the conditions of lake navigation imposed by the width and depth of channels, of the early elimination of which there is little prospect, enforced a precipitate halt upon this ambitious vessel growth. The prevalence of this conviction was reflected in the building program for the past year. The largest vessels constructed on the Great Lakes in 1901 had a length of 450 each, and of the entire fleet of sixty-one new vessels only thirteen exceeded 400 feet length, and two of these were designed for salt water service. In the case of the new contracts negotiated during the closing months of the year the tendency is even more marked Of the forty-five vessels only eight exceed 400 feet in length, and the largest vessels are to be but 436 feet over all—what was deemed two years ago merely moderate size.

The passing of the tow barge is not so strongly emphasized, but it is not less significant. In 1901 only two barges or schooners, as they are termed, were built for service on the Great Lakes, and likewise among the contracts placed during the latter part of the year only two commissions were awarded for craft of the barge type. Some minor changes of policy, quite as radical as those cited, have also been manifest in lake vessel building practice within this recent interval.

LAUNCH OF THE STEAMER NORTHTOWN, BUILT AT CHICAGO, ILL.

For one thing there is the transfer of allegiance from the quadruple to the triple expansion engine. In 1900 thirteen of the largest new steamers were fitted with engines of the quadruple expansion type. Of the vessels contracted for or built during the last half of the year 1901 not a single steamer has other than triple expansion engines. In the matter of boilers there has been a similar revision of opinion. In 1900 water tube boilers were fitted in ten of the largest steel steamers constructed at the lake shipyards. Of the entire aggregate of over one hundred vessels built or contracted for during the calendar year 1901 (including, of course, the vessels designed for delivery during 1902) only four have the water tube type of steam generators.

In point of far reaching influence and interest the

first place in the category of vessels constructed on the Great Lakes since the dawn of the century should be accorded to the two large steamers which have been built at Cleveland for C. E. and W. F. Peck, of New York, for these vessels may be said to constitute the fruits of the first serious effort on the part of the ship building interests of the interior to enter the field as competitors of the shipbuilders on the Atlantic and Pacific coasts in the construction of the heavier class of tonnage. At intervals covering a period of many years past lake shipbuilders have turned out steamers of what has been popularly known as the "canal size" —that is, vessels not exceeding 270 feet in length and of approximately 3,000 tons capacity—which could pass without difficulty from the lakes to the sea through the St. Lawrence canals, which permit a maximum draught of 14 feet; but the two large vessels, which will be taken to the sea coast in sections in the spring of 1902, constitute the initial attempt to enter the general competitive field in the construction of ocean-going cargo-carriers of large size.

LAKE STEAMER URANUS.

These large vessels for salt water service are sister craft of the following dimensions: length over all, 443 1-2 feet; length of keel, 430 feet; beam 44 feet; depth, 34 1-2 feet. They are fitted with triple expansion engines with cylinders 27, 42 1-2 and 73 inches in diameter and 48 inches stroke of piston, to which steam is supplied by Scotch boilers working at a pressure of 170 pounds. The capacity of each vessel on a draught of eighteen feet is 7,000 tons, and the cost of each of the steamers approximately $400,000. These vessels have been constructed in the regular manner at Cleveland, but will be cut in two and taken through the Welland and St. Lawrence canals in sections. It is probable that the experiment will be tried of having the stern section containing the machinery tow the bow through the canals. That this disposition on the part of the lake shipbuilders to enter into competition with similar interests on the seaboard is not an ephemeral thing by any means is proven by the fact that ten of the vessels constructed on the lakes in 1901 were for oceanic service, while several of the vessels now on the stocks for delivery in 1902 are designed for the same trade, and by the further circumstance that the American Ship Building Company, the consolidation of the principal lake shipyards, is now considering the advisability of establishing a plant on the lower St. Lawrence in order to facilitate the reconstruction of vessels which have passed through the canals in sections.

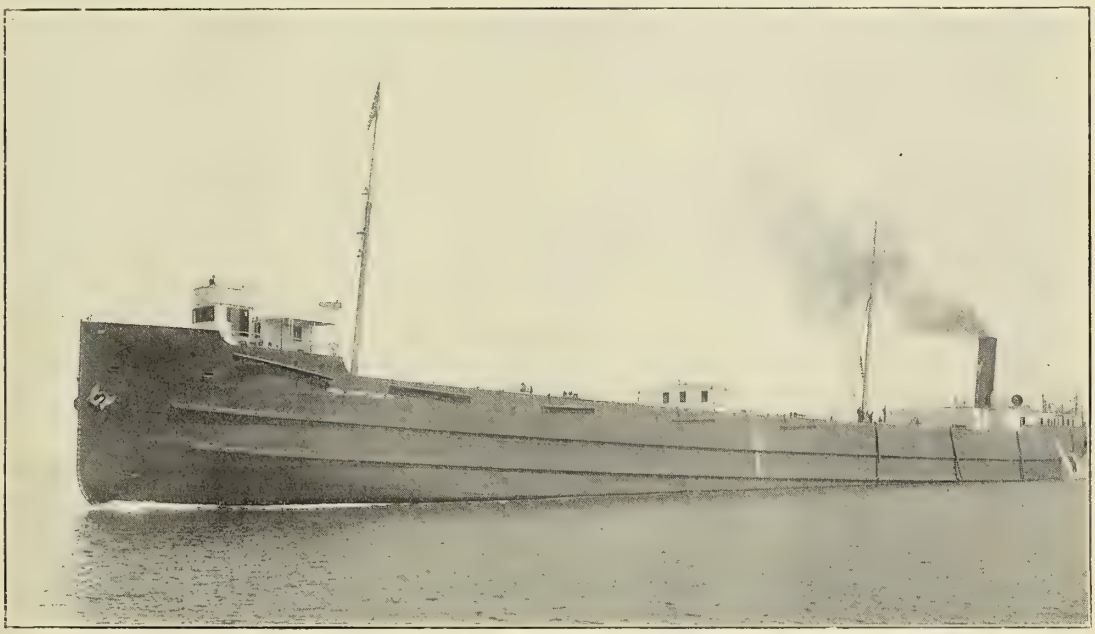
Next in order of importance among the vessels upon which work has been commenced since the opening of the century are the two handsome side-wheel passenger boats for the Detroit and Buffalo Steamship Company, which is to operate, beginning with the season of 1902, between Detroit and Buffalo. The length of the run between these two cities and the desirability of covering the distance in thirteen hours has imposed some rather difficult exactions, and in meeting these there has been evolved a type of speedy passenger boat which it is claimed has no peer in her class.

The vessels known as the *Eastern States* and the *Western States* are each 366 feet in length over all, 350 feet on the water line, 55 feet hull beam, 80 feet beam over all, and 19 1-2 feet molded depth. The walking beam so familiar in most of the large passenger steamers in service on the Great Lakes is absent in these new vessels, the inclined engine having been introduced on the theory that in vessels of this size it is more economical than the beam engine, since it affords greater power and better distributed weight. Steam will be supplied to these triple expansion inclined engines from eight Scotch boilers, and they are designed for 10,000 horse power. The two vessels represent an investment of approximately $1,280,000, and they will be capable of developing a speed of

nearly thirty miles an hour, although ordinary steaming rate when in regular service will not be that high.

In the construction of freighters for cargo-carrying on the Great Lakes the practice heretofore in vogue of contracting for duplicate vessels has been continued to a considerable extent. A thoroughly representative fleet was that constructed at the yards of the American Ship Building Company, at Lorain, Ohio, and Detroit, Mich., for J. C. Gilchrist, of Cleveland, and consisting of the steamers *Mars, Jupiter, Saturn, Neptune, Venus* and *Uranus*. The dimensions of these vessels are 366 feet over all, 346 feet keel, 48 feet beam and 28 feet depth. Propulsive power is furnished by triple expansion engines, to which steam is supplied from Scotch boilers working at a pressure of 170 pounds. The carrying capacity of each vessel is 4,800 tons, and the contract price $215,000.

In view of the oft-repeated rumors of combinations involving a greater or less number of the prominent shipyards on the Atlantic coast, and as an interesting commentary on shipbuilding conditions in general in the lake district, it may not be amiss to glance at the status as to contracts of the American Ship Building Company, which controls seven of the principal steel shipbuilding plants on the inland seas. Of the thirty-seven vessels valued at $8,902,000 building in lake yards at the opening of 1900, twenty-three costing almost $7,000,000 were entered on the books of the consolidation. Of the sixty-one vessels valued at $12,535,000 turned out during 1901, the "trust," so-called, built thirty-six, representing an investment of $9,335,000, and thirty-four of the forty-three contracts for steel vessels placed during the closing months of 1901 for vessels to come out during 1902 went to the consolidation enterprise,

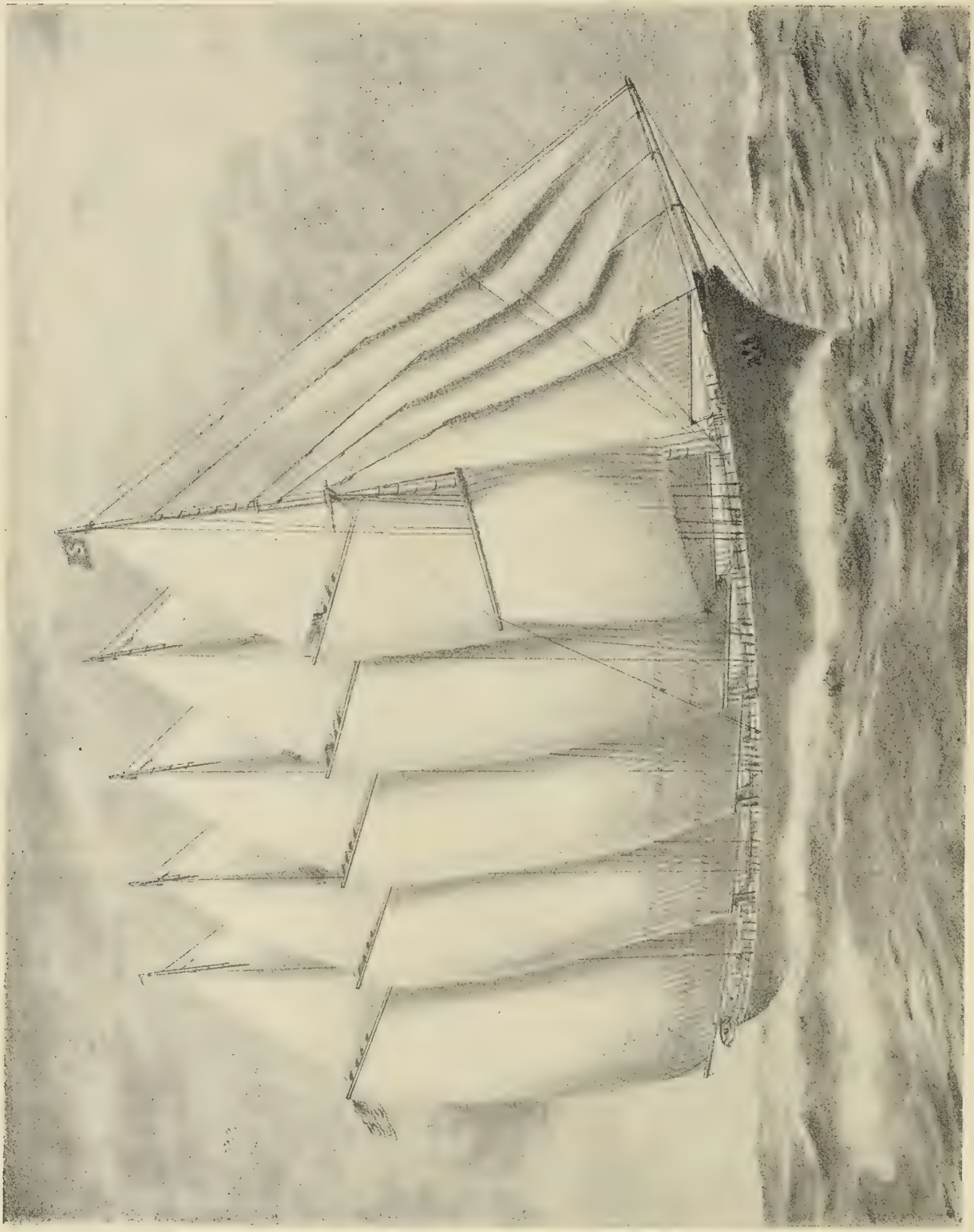


LAKE STEAMER WILLIAM L. BROWN.

The largest cargo-carriers constructed in lake ship yards during 1901 comprised a class of six vessels, the ownership of which was divided between Duluth and Chicago parties. Each vessel is 450 feet in length over all, 430 feet length of keel, 50 feet beam and 28 1-2 feet depth. The carrying capacity is 6,400 tons each. This policy of building a fleet of vessels on a common pattern has been adhered to in the contracts placed during the latter part of 1901 for delivery some months later. Among these vessels to come out early in 1902 there is a class of four vessels each 436 feet in length over all; an equal number of steamers building have a length of 434 feet over all; there are seven 400-foot boats, and ten vessels having the uniform dimensions of 366 feet over all. Included among the vessels turned out during 1901 were two steamers and two barges designed especially for the transportation of copper ore. The steamers are each 336 feet in length, and the barges 312 feet, and all four have a uniform carrying capacity of 4,000 tons.

which thus has on its books $8,730,000 of the new business to be found in the steel shipbuilding plants on the Great Lakes at the dawn of the second year of the new century.

Coal Steamer Mercedes.—A coal steamer for trade between Australia and the west coast of America was recently launched at the Northumberland Shipbuilding Company, Ltd., Howden-on-Tyne, and is equipped with a system for rapidly loading and discharging cargoes of coal and general merchandise. The engines are located aft, like our lake steamers. There are four hatchways 22 feet wide, worked by derrick posts 40 feet high from the deck with eight derricks equipped with the Temperley system of transporters. It is expected that a cargo of 7,000 tons may be discharged from the steamer in sixteen hours. The water ballast amounting to 2,400 tons will bring the ship down to a good draft when without cargo.



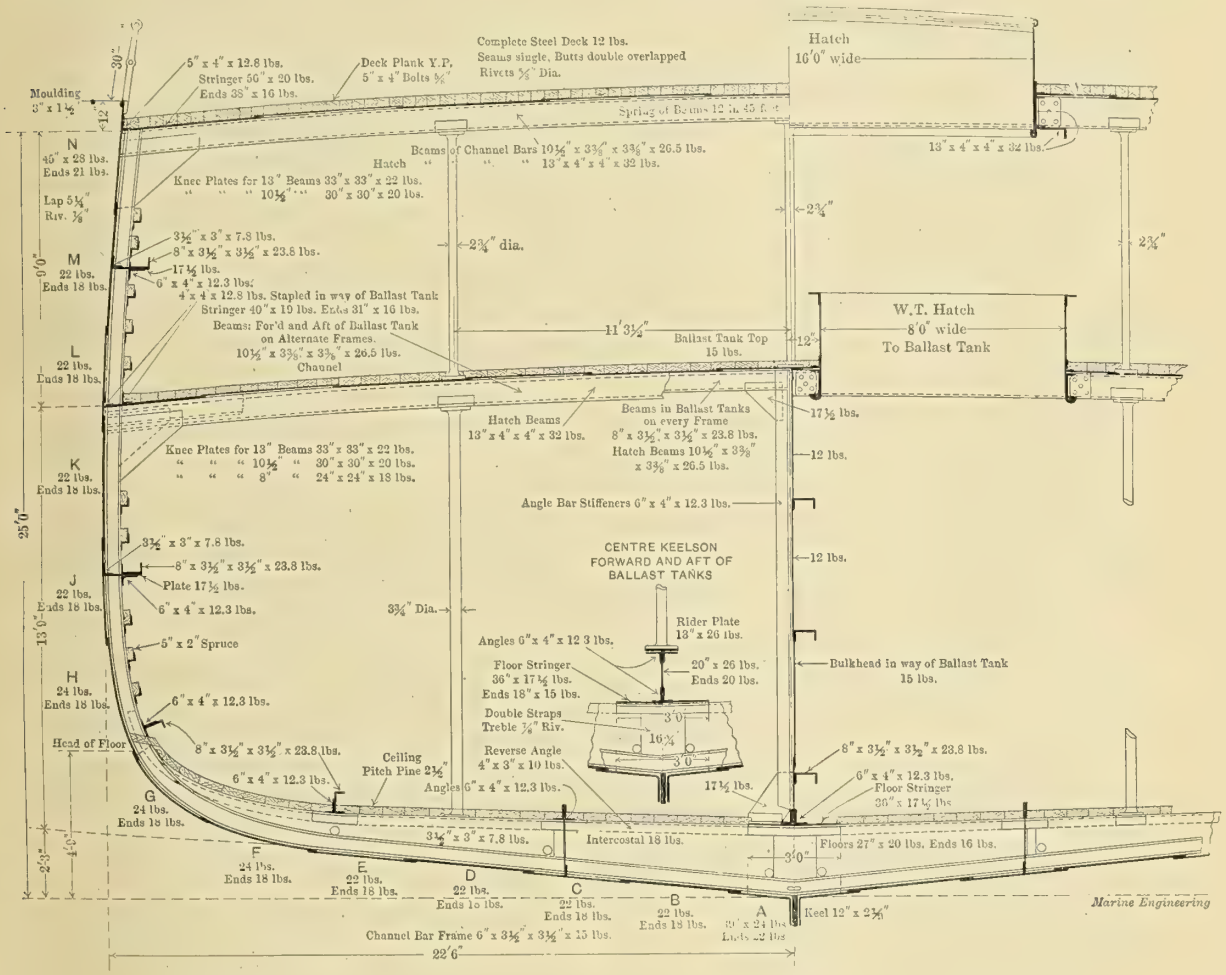
FIVE MASTED STEEL SCHOONER.

MODERN FIVE MASTED SCHOONER.

JAMES A. HARGAN.

There are not a few who really believe that the death knell for the days of sailing vessels has long ago been sounded and that they are now a dream of the past. Let me gently wake all such from their dream, not with a sudden clash of dry statistical figures, but with a few plainly stated facts.

The graceful clipper ships of which we were so proud a few years ago, it is true, have largely disappeared. The ocean tramp and other steamers have been crowding them out of business, but there are still a goodly



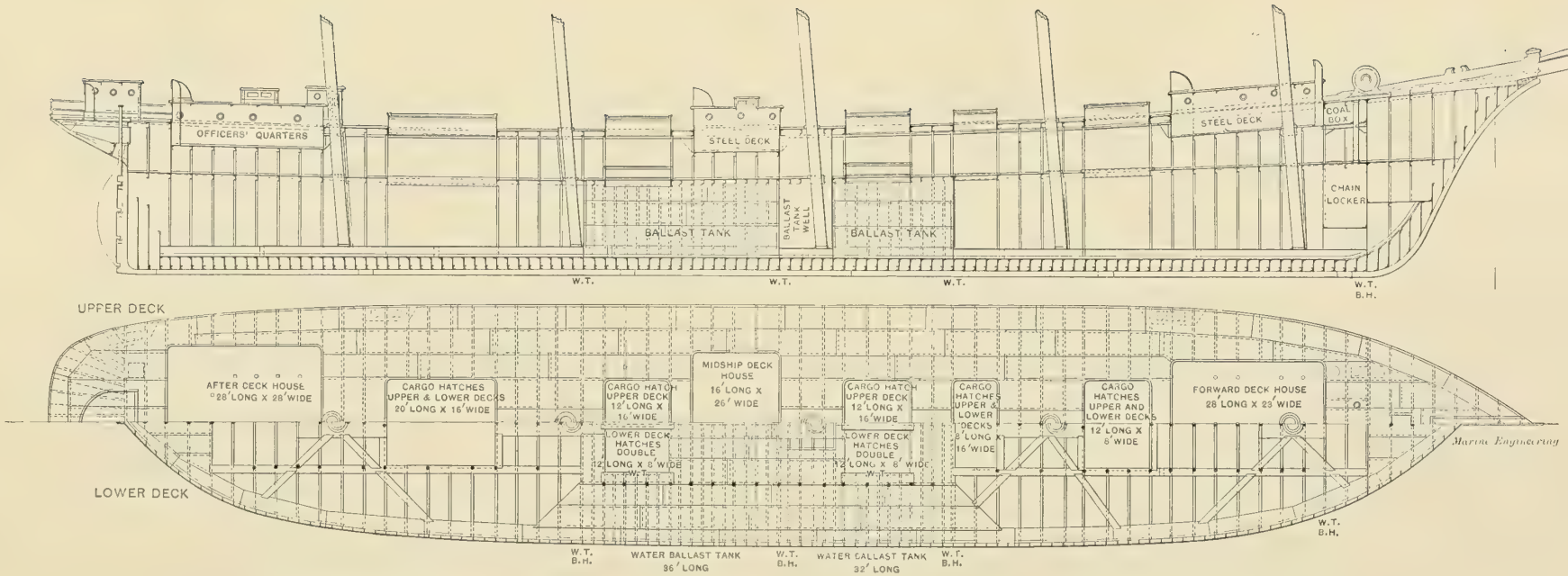
MIDSHIP SECTION OF FIVE MASTED SCHOONER.

number of fine sailing vessels of this order on the ocean, and being built even in this the twentieth century, many of them much larger and heavier than of old, and are found by their owners to be still a good paying investment. Especially can this be said of the schooner type of coasting trader when built and equipped in an up-to-date manner; but even in this class the small fry are being rapidly run out by the big ones, and all along our eastern and southern coasts we find a brisk movement in the building of these large schooners. But, strange to say, the large majority of these vessels, in point of number, is being built of wood. This, of course, is readily explained, since the first cost of a wood vessel is materially less than a steel one. The latter has of course many advantages in point of economy, durability, etc., over the former, which, however, it is not the writer's purpose to discuss in this article. Suffice it to say that as the size of these vessels increases the necessity of using steel construction becomes more urgent.

The pioneer of the steel sailing ship builders of our country is the well-known firm of Arthur Sewall and Co., of Bath, Me., who are not only extensive builders, but own and operate a large fleet of sailing vessels which trade to all parts of the world. A few words about this firm will certainly interest all American readers who are interested in our shipbuilding and maritime progress.

The firm of Arthur Sewall and Company has been in existence and constant working order since 1823, and from that time to the present they have kept up an unbroken record in the construction of sailing vessels, over one hundred of which have been built.

Their first vessel of wood was the brig *Diana*, of 314 tons, built in 1823. This was followed by others of gradually increasing size, and in 1841 they built the



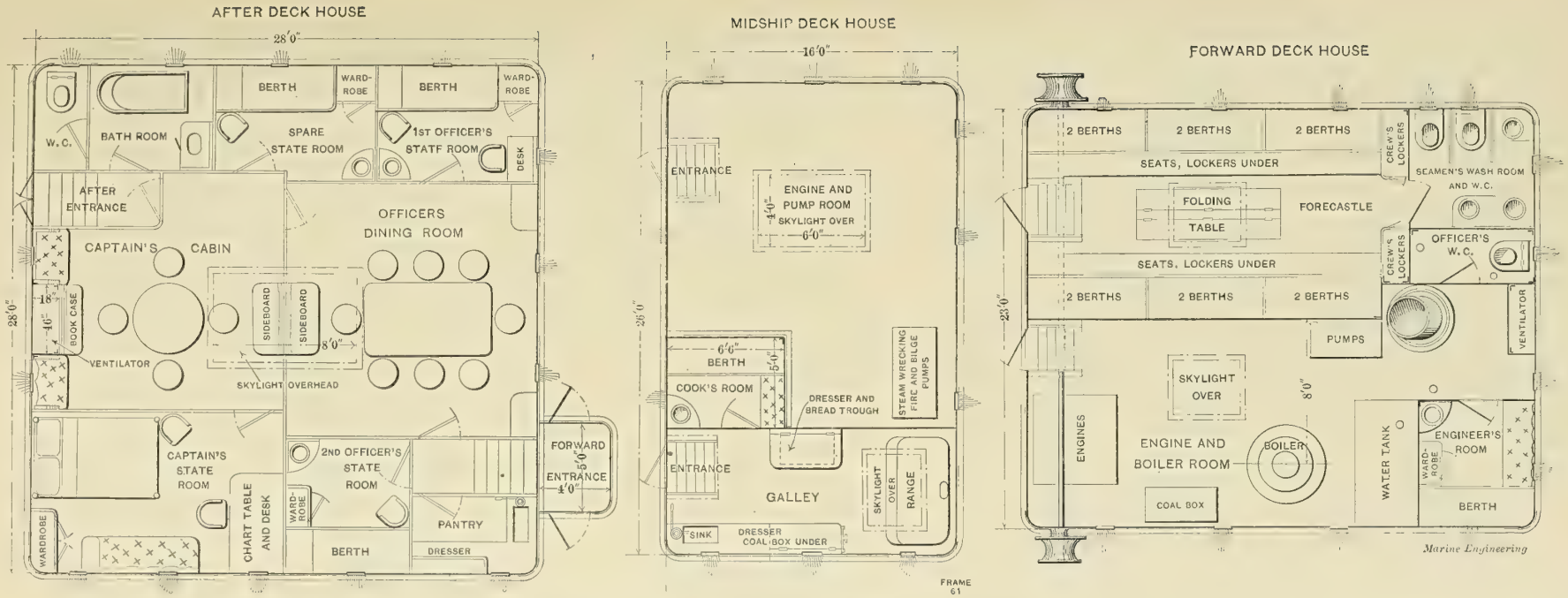
LONGITUDINAL SECTION AND DECK PLANS OF FIVE MASTED SCHOONER BUILDING BY ARTHUR SEWALL AND COMPANY.

ship *Rappahannock*, of over 1,000 tons register, at this time the largest American sailing ship afloat. Still the demand was for larger ships. In 1893 the firm became convinced of the necessity of building steel ships. Consequently, in order to keep pace with modern requirements and demands, they entered the field as steel ship builders, and during the year 1893 built and launched the first steel sailing ship constructed in the United States, the *Dirigo*, of 3,000 tons. Since this time they have built many fine specimens of sailing ships, barks, etc., that are famous as good sailers and carriers the world over. Among these may be mentioned the ships *Erskine M. Phelps, Arthur Sewall, Edward Sewall, Wm. P. Frye, Acme*, the bark *Kaiulani*, and many others.

The yard is splendidly located on the banks of the Kennebec River, with deep water right up to their wharves. It is fully equipped with the best modern appliances and tools for the business, and this firm is perhaps the only one in the country making an exclusive specialty of steel sailing vessels.

The firm is now building several large steel sailing vessels, among the number being the ship *Atlas*, of about 3,500 tons, for the Standard Oil Co. This vessel is nearing completion and was recently launched. Recent orders have been placed with the Carnegie Steel Company for the material to build a mammoth steel double-decked five-masted schooner as an addition to their own large fleet of vessels, plans of which accompany this article. This craft will possess many novel features in construction, general arrangement and detail of fitting, all conducive to the safety, speed and usefulness of the vessel, as well as to great economy in handling. Among her principal features will be an arrangement for carrying 1,242 tons of water ballast in bulk without having recourse to the double bottom system usually adopted by steamers for this purpose. To attain the results desired a series of ballast tanks has been designed, extending in height to the lower deck. These tanks are each fitted with large water-tight cargo hatches, so that when in ballast the hatches can be closed absolutely water-tight, or, when in freight, can be used as ordinary cargo hatches, making the ballast tanks available as holds for cargo of any description, thus giving the full freight capacity of the vessel's hold, which could not be had with a double bottom, and materially diminishing the cost of construction and subsequent care.

At the same time this makes a much stronger and safer vessel by the increased water-tight subdivision formed by the additional bulkheads, deck plating and beams. The great advantages and economy accruing from the use of water for ballast needs no more comment than that it can be safely and quickly loaded or discharged, and at no further cost than the mere nomi-



PLANS OF STEEL DECK HOUSES ON FIVE MASTED SCHOONER.

nal one of running the pumps; and the vessel will be fully equipped with ample steam pump capacity for this purpose. The pumping station will be located in the midship deck house, the pumps being connected directly to the tanks through the pump well adjoining, and extending from the keel to the upper deck. This pump well will be entered from the deck house through a water-tight manhole, thus affording access to all the pipes, valves, etc., at all times, whether the vessel is filled with cargo or the tanks with water ballast, all valves and pipes from the pumps to the tanks and from the sea to the pumps being located in this pump well. Steam pump connection is also provided for each of the vessel's holds or bilges, in addition to large hand pumps for this purpose, which, in their turn, may be driven by steam power from the hoisting engines located in the midship deck house. These hoisting engines are threefold in purpose; they are arranged for handling cargo, for handling the vessel's sails, etc., and for working the hand pumps by messenger chains.

The ship's galley and cook's room is also located in the midship deck house, and the floor of the galley, engine and pump room will be covered with cement and handsomely tiled.

The main hoisting engines will be located in the forward deck house, and these engines will also have a threefold purpose: for handling cargo, for handling the vessel's sails, etc., and for handling the vessel's anchor chain and warps through the large specially designed windlass and capstan, which may also be operated by hand.

The two main bower anchors will be of the latest improved stockless type, thus being carried in the hawse pipes constantly ready for use, and abolishing the necessity of fitting anchor davits or catheads, and materially simplifying the labor of handling and stowing the anchors. The boiler which supplies steam for the engines, pumps, heaters, etc., is located in the forward deck house, and is of the vertical cylindrical type.

Should the vessel be placed in foreign trade requiring long voyages, a distilling and evaporating plant will be added. The floor of the forward engine and boiler room will be covered with cement and handsomely tiled. The engineer will have a state room in the forward deck house. The seaman's forecastle, with accommodations for twelve men, the officers' water closet and seamen's head and wash room are all located in the forward deck house, special care and at-

tention being given to the lighting and ventilating of each room, and all plumbing will be of the latest improved sanitary type for ship's use, thereby insuring the health and comfort of the vessel's crew.

The after deck house is arranged for the accommodation of the captain and officers, with spare state-room for the owners or passengers. A special cabin, state-room and bathroom is provided for the captain, a special state-room for each officer, with a dining room and pantry common to all. These quarters will be handsomely finished in hard wood, with all modern conveniences and appliances for the health and comfort of the occupants.

Abaft of the after deck house will be located the chart or wheel house, in which will be located the steering gear, which will be of the latest improved screw gear hand-power type. This house will be built of steel, with circular after end and square front, the fore end, having heavy plate glass windows, and circular air ports on the sides.

The forward, midship and after deck houses will all be built of steel on the trunk deck pattern, extending only about 4 feet above the upper deck, the sides continuing down to the floor beams, forming strong fore and aft girders, connecting with continuous fore and aft girders under the upper deck on each side of the cargo hatches and thoroughly supported with beam stanchions, thus strengthening the upper deck for a heavy deck load when necessary. The beams forming the floor of the forward and after deck house extend from side to side of ship, thereby adding greatly to the vessel's strength and resistance to panting. The five enormous masts and spike bowsprit will be all of steel.

The vessel will be built to the highest class A1, twenty years under the America Bureau of Shipping, and will equal in scantling and construction the highest classification given by Lloyds Rules, and when completed will undoubtedly be one of the largest, handsomest, best appointed and most economical vessels of her type on our extensive seaboard. She will be equally serviceable for coasting or foreign trade, and will be a marked advance over any of her present compeers. The designs were prepared by the writer.

The principal dimensions of the vessel are as follows:

Length over all	274 ft. 9 in.
Length registered	251 " "
Beam	45
Depth molded	25 " 0 "
Load draft (from bottom of keel)	21 " 0 "
Corresponding displacement	4530 tons
Deadweight carrying capacity	3132 "
Area of immersed midship section	828 sq. ft.
Coefficient of immersed midship section	.92
Block coefficient	.728
Prismatic coefficient	.792
Tons per inch of immersion at load draft	22.35
Cargo Capacity	176000 cu. ft.
Capacity of water ballast tanks	1242 tons
Sail area including square fore sail	25920 sq. ft.

Inspector of Boilers.—The United States Civil Service Commission announces that on April 22-23 an examination will be held in leading cities throughout the United States for the position of Inspector of Boilers in the Steamboat Inspection Service at Dubuque, Iowa, and other similar vacancies as they occur, at a salary of $1,500 a year. Persons desiring to compete should apply to the commission, Washington, D. C., before April 12th for rules covering the examination.

The Wreck of the Steamer Grecian.

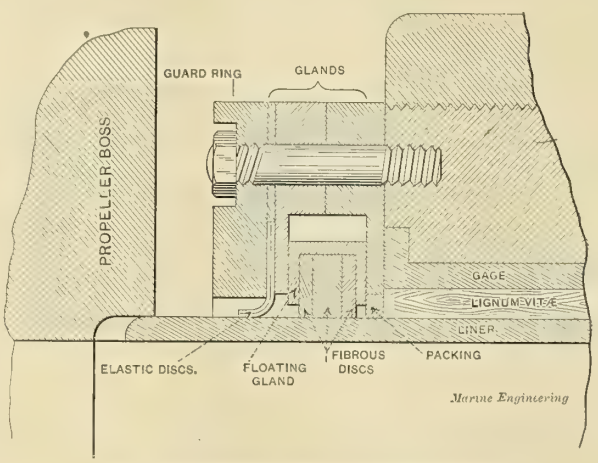
This winter's storms have caused the wreck of many a ship in the north Atlantic service, and the accompanying views illustrate the sad fate that may await a ship that once leaves her native element. The Allen line freight steamer *Grecian*, bound for Halifax, N. S., went ashore on February 9th near the entrance to the harbor of Halifax during a snow squall. The vessel struck on the rocks as shown, and although attempts were made to float her off they were unsuccessful before a severe storm on the 17th drove her still further on shore and broke her in two, as shown in the lower engraving, which was taken the day after. The force of the waves on this rock-bound coast is well shown by the high bank of spray at the left, which is a sea breaking over the bow. The upper illustration was taken a few days later and shows the further damage to the vessel. The hull amidships is practically washed away, opening up the engine and boiler rooms. One section of the plating has been washed up on the rocks.

The *Grecian* was built at Sunderland, England, in 1879, and is 360 feet long, 40 feet 2 inches beam, 31 feet deep, and of 3,481 gross tons. Captain Harrison, who commanded the ship, testified at the inquiry into the loss of the vessel that there was a slight deviation of the compass. If he had not taken a pilot on board he would not have attempted to come into the harbor at that time.

Lubrication for Tail Shafts.

A device for preventing the corrosion of tail shafts, by filling the stern tube with oil, has been brought forward by Messrs. Benjamin R. Vickers and Sons, of Leeds, England.

In the system illustrated the oil is supplied auto-



OIL RETAINING RINGS AT STERN PORT.

matically, and a continuous circulation is maintained without requiring the attention of the engineers.

Oil flows into the stern tube from a reservoir placed on the deck, and there becomes slightly heated by friction. Then it passes back through the up-flow pipe and is replaced by the cooler liquid. Testing cocks and pipes are provided and the apparatus is so arranged that the engineer can readily see if it is working properly. The oil used must be free from acids, otherwise

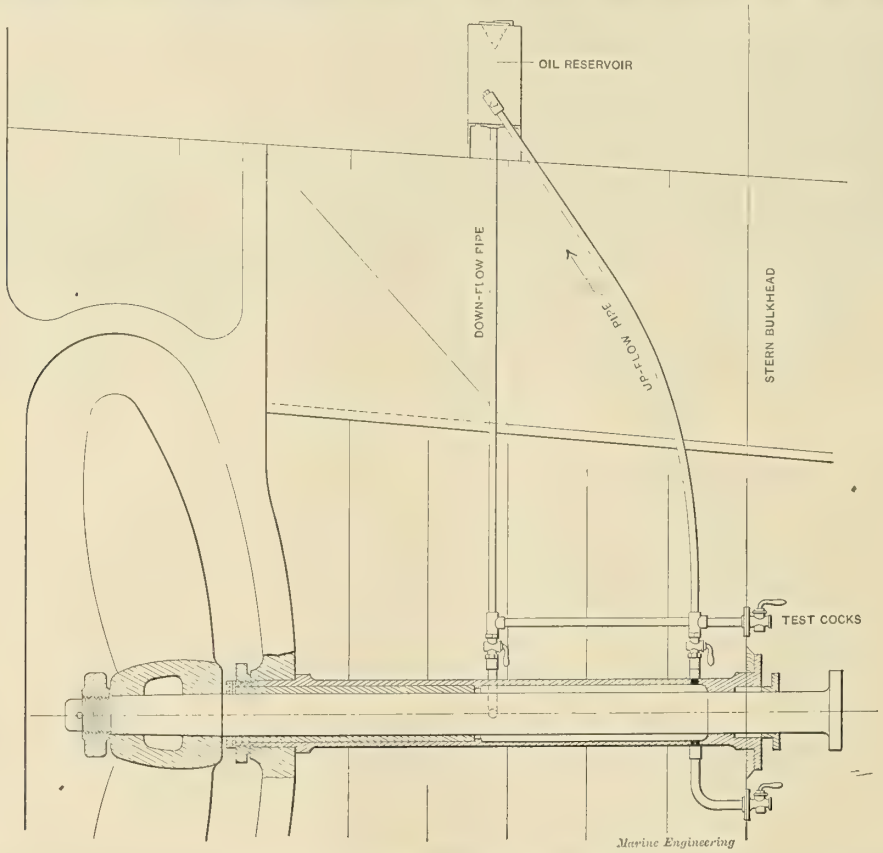
WRECK OF THE GRECIAN. VIEW TAKEN AFTER SECOND STORM.

THE FREIGHT STEAMER GRECIAN WRECKED NEAR THE HARBOR OF HALIFAX, N. S. ON FEBRUARY 9TH. VIEW TAKEN AFTER FIRST STORM.

Photo. by Gauvin & Gentzel, Halifax, N, S,

corrosion will set in almost as serious as that resulting from the salt water. For further clearing the oil, a filter is placed on top of the reservoir.

A patented oil-retaining appliance is attached to the stern tube entirely independent of the propeller, consisting of specially prepared fibrous and other disk packing rings fitted round the shaft and protected from the sea. The fibrous material expands when in contact with the oil, making a tight joint without causing friction. The detail drawing illustrates the construction. They are fitted in a floating sheath, which rises and falls with the shaft and which works inside a metal



SYSTEM OF LUBRICATING TAIL SHAFT.

gland. Outside these and under the guard ring are two elastic disks, the inner edges of which lie along the shaft between it and the guard ring, so that in case the stern bush should become worn these would be pressed close round the shaft by the pressure of the water and will assist in keeping the oil in the stern tube and the water and sand out.

This system can be readily applied to old ships and no alterations are required to the stern tube or bush. The rings are made in halves and can be fitted without removing the propeller. For new ships the patentees recommend a linerless shaft, running in a cast iron or white metal bush, with suitable grooves for the oil to flow freely through both the stern bushes. It is claimed for this arrangement that it will be both cheaper and give more satisfaction than the present forms.

In April, 1901, the twin-screw channel steamer *Ibex* was fitted with this patent system. The vessel steams 18 knots, and has 11-inch shafting running 145 revolutions per minute. Much trouble had been previously experienced from sand getting into the stern tube, but since the above date sand has been kept out, and very little, if any, wear in the stern bearing has been noticeable.

Wreck of the Steamer Wilster.

During the stormy night of February 28th, the tramp steamer *Wilster*, Capt. G. O. Tookes, from Malta to Boston, went into the breakers on Cape Ann, Mass., and stranded hard and fast on a ledge in a most dangerous position. The accompanying illustrations were taken after the storm had gone down. The vessel first struck on Salt Island but worked herself off, and while Capt. Tookes was feeling his way along the shore the steamer again struck on the beach. Signals which the vessel sent up were seen by people along the shore, and lifesavers soon came to the rescue and took off the members of the crew in the breeches buoy. The ship was loaded with sugar, and her cargo has been discharged and efforts are being made to float her.

Several attempts were made by tugs and the wrecking company to pull the stranded steamer off. Most of her cargo of sugar was lightered from the ship and towed to port, but then the combined pull of all the tugs was not successful in floating the ship. On account of excessive storms the vessel was driven further on the beach and deeply imbedded in the sand, and at the time of going to press it is doubtful if the ship will be gotten off.

BOW VIEW OF THE STRANDED STEAMER WILSTER.

STEAMER WILSTER STRANDED ON LONG BEACH, ROCKPORT, MASS.

Photo. by R. W. Phelps, Gloucester, Mass.

LIGHT DRAFT HYDRAULIC DREDGE.

Inside of the low coast line of the Gulf of Mexico there stretches a series of shallow lakes and bayous, the utilization of which will form part of a system of improved inland navigation. This scheme, which has been projected by Captain C. S. Riché, Corps of Engineers, Galveston, embraces the dredging of existing bodies of water, and the cutting of connecting canals forming eventually a water way for light draft steamers, from the Mississippi river to the Rio Grande, and is intended to serve as a feeder to the ocean commerce of the port of Galveston. For the prosecution of this undertaking a light draft dredge was required, and the work of designing and preparing the necessary drawings and specifications was entrusted to Captain Mason M. Patrick, Secretary of the Mississippi River Commission, St. Louis, and accomplished by Mr. Thomas Middleton, the consulting engineer of that department.

The special requirements controlling the design were: that the dredge should not exceed 4 feet draft; that the hull should be of wood in order to reduce first cost and facilitate repairs in the field; that it should be self-propelling; that it should be capable of dredging stiff clay as well as sand, gravel and shells; that it should discharge on either side and at an elevation for the making of banks, also by means of a floating pipe astern; that the dredge should be provided with means for removing snags embedded in the cuts; should be adaptable for service in salt water; should be fitted with tools suitable for making repairs in the field; should have ample cabin accommodation for crew, and finally the cost was not to exceed $60,000. In order to fulfill this last requirement and at the same time obtain a dredge having a pumping outfit of fair capacity, it was decided to make separate contracts for the various units which were indispensable; to erect the machinery by hand labor; and to purchase other desirable accessories and a more complete outfit later on, when further appropriations will be available. This procedure was very satisfactory and resulted in making contracts at the following figures:

Hull	$10,930.00
Main Pump and Engines	8,338.00
Propelling Engines, shafts and propellers installed	5,025.00
Boiler and Fittings	3,945.00
Surface Condenser with Air and Circulating Pumps	2,498.00
Suction frame, fittings for discharge pipes, shear legs, etc., and steam spud lift	5,293.50
Plate steel pipes in connection with main pump, including spudwell and ash chute	800.00
One jet pump and two feed pumps	1,600.00
Distilling plant	1,090.00
Refrigerating plant	1,295.00
Electric light plant, exclusive of wiring	1,050.00
Total	$41,864.50

Thus allowing about $18,000 for building cabin, installing machinery and purchasing minor machinery outfit, and general furnishing.

DETAILED DESCRIPTION OF HULL.

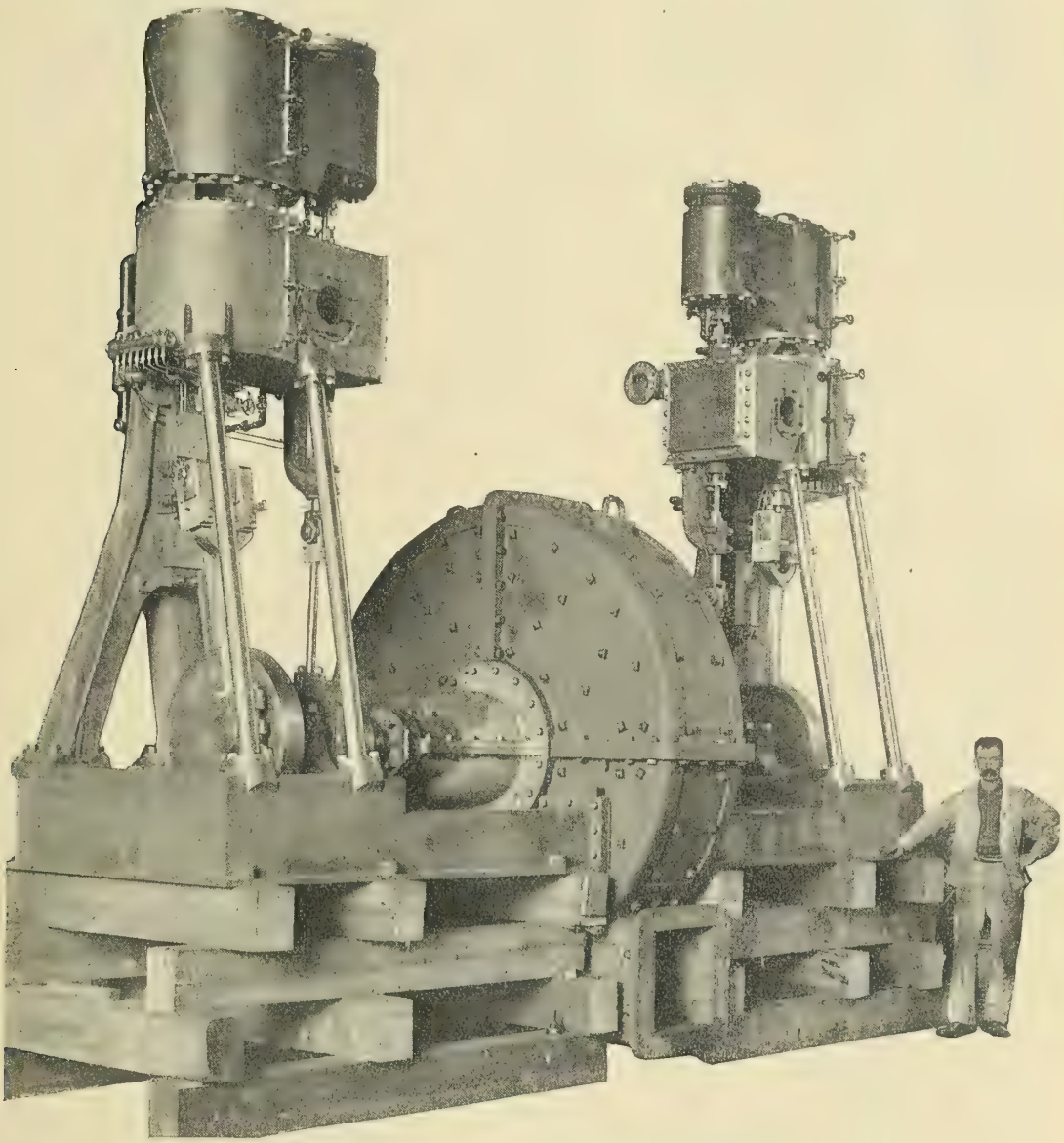
The hull is 132 feet long; with a projecting fan-tail of 6 feet; 32 feet wide and 7 1-2 feet deep, molded dimensions; the deck having a crown of 8 inches makes the total depth at center line 8 feet 8 inches. A recess is formed in the bow 10 feet wide and 22 feet long, in which the suction frame is placed, and all the machinery, except the jet pump and boilers is placed in a pit 18 feet wide and 50 feet long. The hull is built of long leaf yellow pine throughout, with the exception of knees, which are of mulberry or live oak, and is sheathed to a height of 4 feet 6 inches from the bottom with 1 inch boards thoroughly creosoted, over a layer of tarred sheathing felt. The dimensions of the principal scantlings are as follows: Floor timbers sided 5 inches molded 8 inches in the straight body, diminishing to 6 inches at the rakes; frames sided 5 inches molded 8 inches at butt and 5 inches at head, secured to floor timbers by futtocks and side plates; frames at side of suction well and engine pit sided 5 inches, molded 6 inches; deck beams sided 6 inches, molded 13 inches at center and 5 inches at ends. Special deck beams sided 13 inches and 11 inches are placed at ends of well and engine pit, etc. The clamps are sided 4 inches, molded 10 inches, shelf pieces sided 4 inches, moulded 8 inches; and the bilge clamps are sided 5 inches molded 22 inches at the straight body diminishing to 12 inches at the rakes. The bilge clamps land on the futtocks and are bolted through the knuckles at every frame. The two middle keelsons running aft from suction well are 6 inches wide and 10 inches deep, and the two side keelsons are 8 inches wide and 10 inches deep, all diminishing to 5 inches deep at the rakes. The sides of engine pit are formed by riders 18 inches deep on top of side keelsons and 3 inches planking up to deck. The floor beams for engine pit are sided 4 inches molded 8 inches and spaced at 18 inches centers. All planking is 3 inches in thickness, strakes below water line 10 inches or 12 inches wide, above water 6 inches wide, and deck 5 inches wide. The hull is divided into four compartments by three transverse water-tight bulkheads, framed and planked same as hull. Reference to the diagrams will show clearly further details of the construction of the hull.

DREDGING MACHINERY.

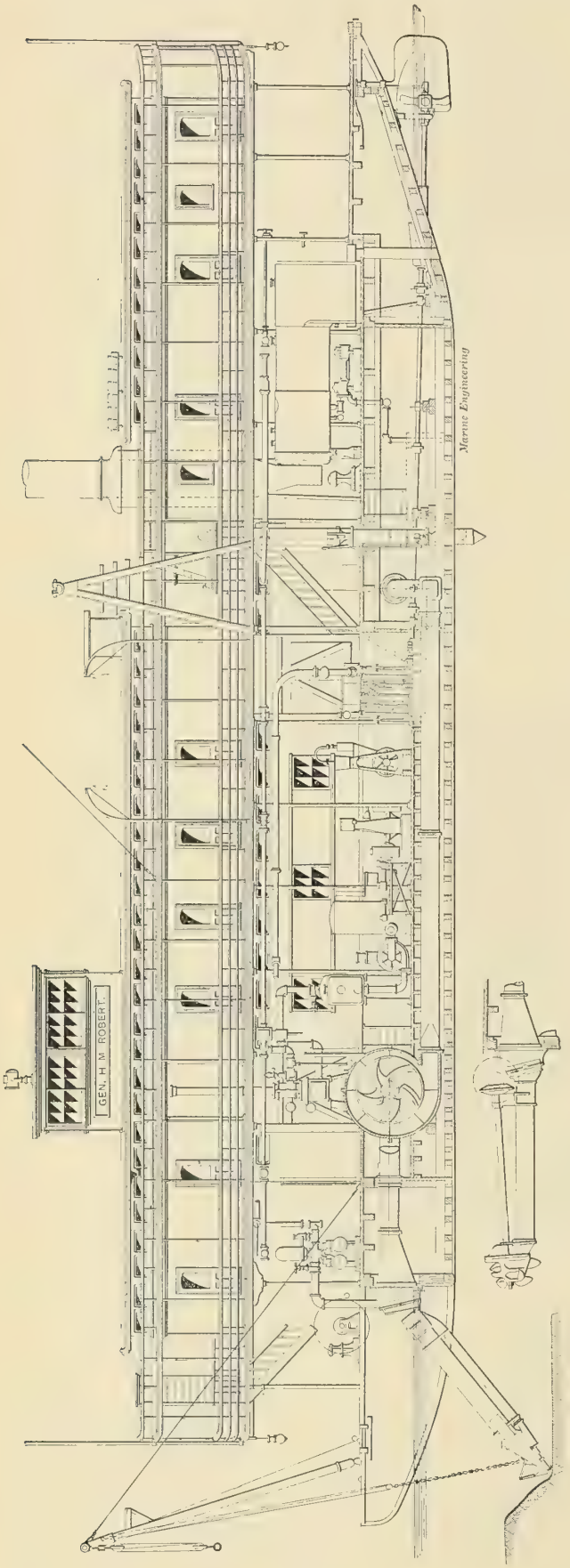
The main pump is of the centrifugal type now so generally used for dredging sand and mud, but embodying such improvements as have been dictated by experience in the large dredging operations carried on annually for the maintenance of navigation on the Mississippi river, during the low water season. The runner is 72 inches in diameter and is of the enclosed type, consisting of a spider with five blades, to which are riveted side plates of steel, 1-2 inch thick. The blades are made concave on the driving side in order to prevent guttering at the points of contact with the side plates, due to the attrition of the sand in flowing through the runner. The pump casing is made with paralleled sides to facilitate the use of renewable liners; and is divided into parts to admit of easy handling for inspection and repairs. The inside of casing and the runner are machine finished. Steel

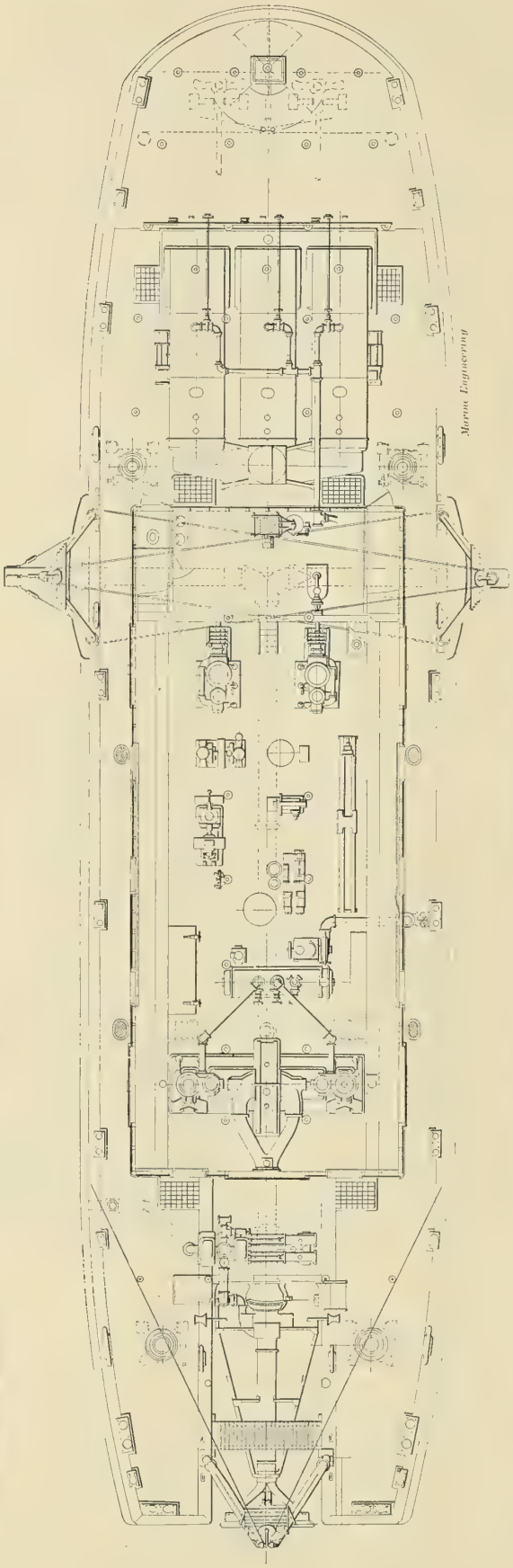
plate liners 5-8 inch in thickness are used on each side of the runner, cast iron liners 3-4 inch in thickness on the sides of casing beyond the runner, and steel plates 1-2 inch thick on the circumference. The throatliners are of cast iron and are held in place by the bolting of suction elbows to the casing. The suction pipe is divided as it approaches the pump and enters on both sides, thus placing the runner in equilibrium, and dispensing with the thrust bearing which is necessary in single suction pumps. The pump is driven by a vertical triple expansion four cylinder engine arranged in two units, the shafts being connected to the pump shaft by flanged couplings. The high pressure cylinder is 14 inches in diameter; the intermediate is 21 inches and the two low pressure cylinders are each 23 1-2 inches diameter, with a common stroke of 18 inches. The engines will run at 150 revolutions per minute giving the pump a peripheral velocity of 47 feet per second, which will maintain a head of 34 1-2 feet with a pump efficiency of 60 per cent. With reduced efficiency as the pump wears the engine revolutions can be increased to maintain the desired head. The general arrangement of engines and pump is shown in the engraving below.

The dredge will at first be fitted for sand digging only; the machinery and cutter head for handling stiff clay and other compacted material will be added later on. The suction frame for sand digging is shown on page 180, and consists mainly of a 20-inch pipe attached to a channel bar frame and working on a ball and socket joint and a pair of trunnions attached to the hull of the dredge. The mouthpiece is 9 1-2 feet wide and is fitted with screen-bars to prevent large drift from passing into and choking

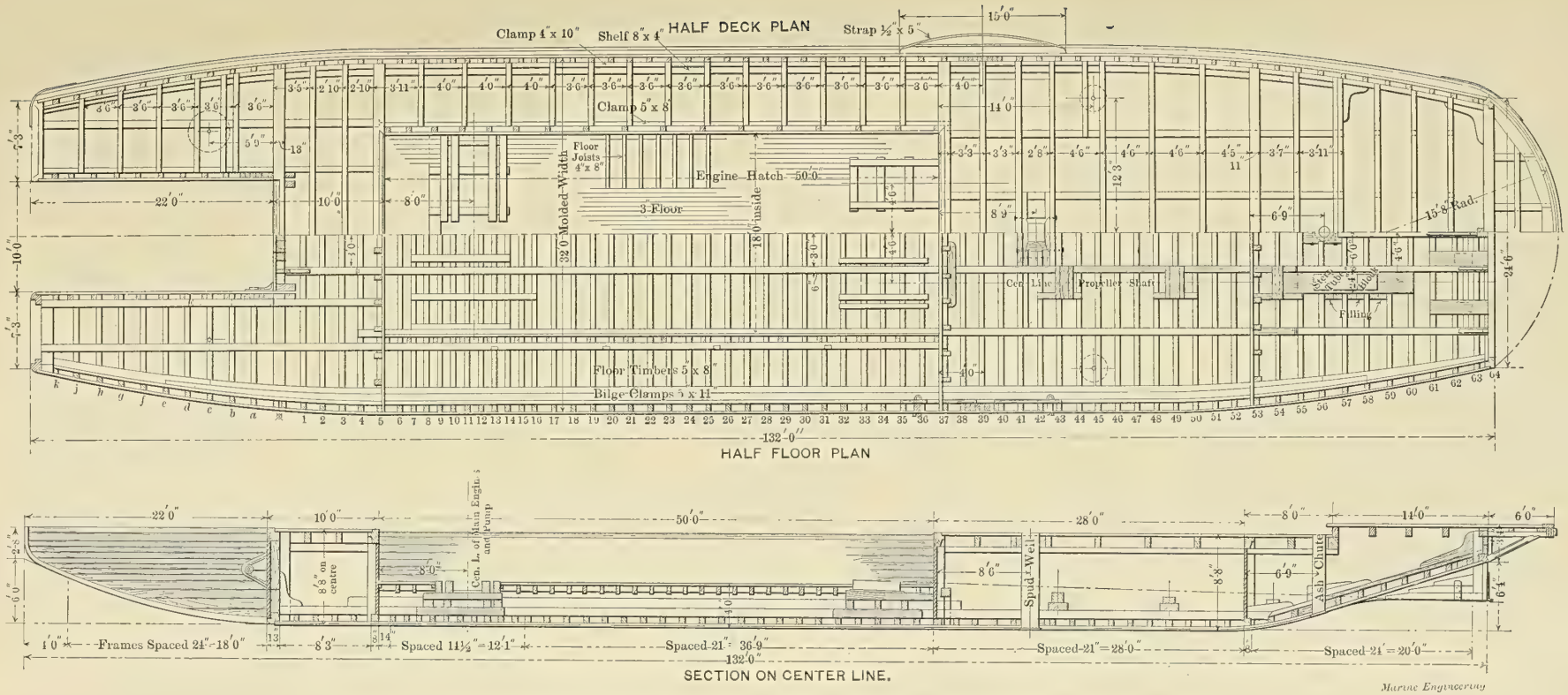


TRIPLE EXPANSION ENGINE DRIVING CENTRIFUGAL DREDGING PUMP





ELEVATION AND PLAN OF MAIN DECK OF HYDRAULIC LIGHT DRAFT DREDGE, GEN. H. M. ROBERT.
Small view to the left is the Cutter Head to be used when Dredging in Clay.



DECK PLANS AND SECTIONAL ELEVATION ON CENTER LINE OF LIGHT DRAFT HYDRAULIC DREDGE.

the pipe. This mouthpiece is fitted with a water jet agitator for loosening the sand to be removed, and consists of a header from which seven pipes lead radially to the underside of the mouth, the pipes being reduced at the ends to form 5-8 inch nozzles. The water is supplied to jets at pressures up to 100 pounds per square inch by a duplex compound steam pump, with cylinders 8 inches and 12 inches diameter, plungers 10 inches diameter and a stroke of 12 inches. This pump can also be used for fire purposes, and is arranged to admit high pressure steam into the low pressure cylinders when the higher pressures of water are required.

The discharge from the main pump is taken underneath the floor of the engine room by a 20 inch pipe to a Y branch fitted with a swing valve by means of which the dredged material can be discharged on either side of the dredge as desired. The outboard delivery pipes are carried by a ball and socket joint at the side of the dredge and are suspended from shear legs by which means they can be raised or lowered as occasion may require for depositing the spoil on shore for bank building, or discharging into sloughs alongside the dredged channels. Where the spoil has to be dumped at any considerable distance, a pontoon pipe line will be used.

When working in soft, free flowing material the dredge will be fed into the cut by head cables anchored at convenient distances and hauled in by the steam capstans on forward deck, shown on the general plan. These capstans are driven by pairs of horizontal engines with 6-inch cylinders and 8-inch stroke. A pair of smaller capstans with 5-inch by 7-inch engines are placed abaft the engine house for handling the discharge pipes and general purposes. When dredging in hard material, which requires the cutter head to disintegrate it, the feeding will be done by swinging from the spud anchor located at the after end of engine house. Head lines will be used for the advance

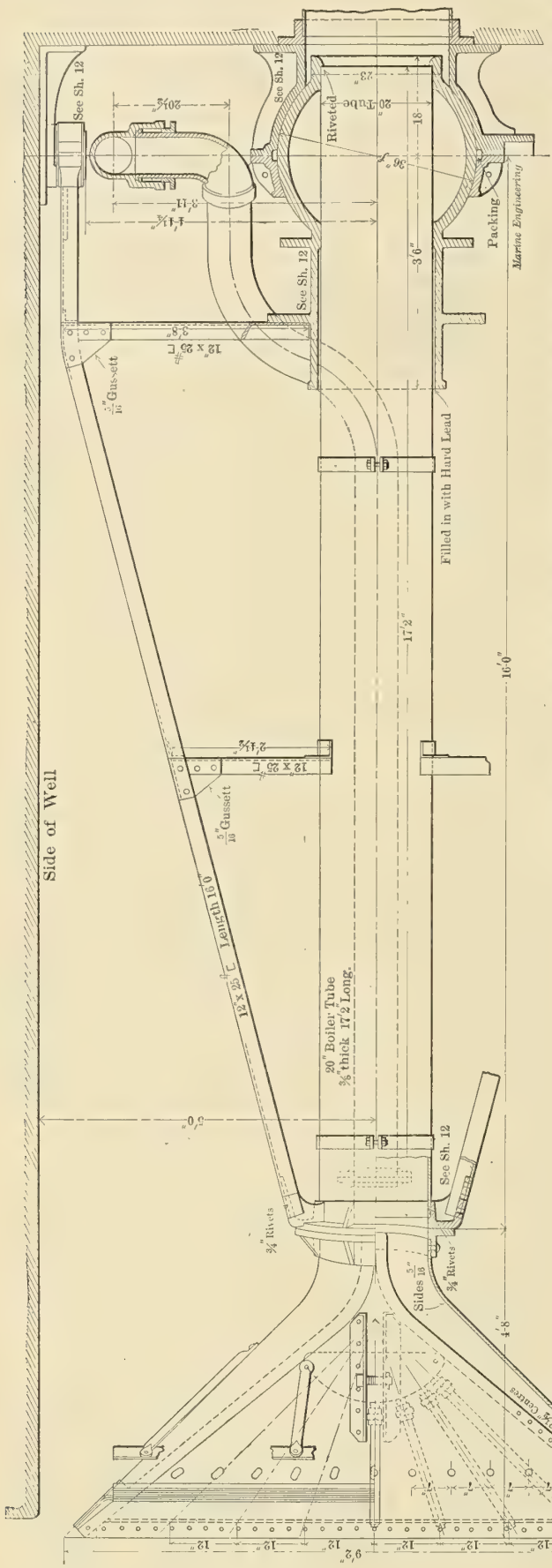
and breast lines for the swing. The spud anchor is raised by means of a steam cylinder 15 inches diameter and 6 feet stroke, and is dropped by a tripping dog, which engages in a rack on the face of the spud. The bow shears are made from selected sticks of yellow pine 10 inches square and are intended for use in clearing the channel from snags as well as for handling the suction heads.

PROPELLING MACHINERY.

The dredge is propelled by twin screws 4 feet 9 inches diameter and 5 feet 9 inches pitch, fitted with removable blades. Owing to the shallow draft of the boat the propellers project 12 inches above the water line and are covered with hoods, which will give the same effect as though they were entirely submerged. The engines are compound, with high pressure cylinders 12 inches, low pressure cylinders 22 inches in diameter and 12 inches stroke, and are located at the after end of the engine room. This gives unusually long intermediate shafts, but what little disadvantage there may be in this respect is amply compensated for by the greater convenience in having the machinery concentrated in one engine room and in charge of one engineer. The surface condenser is of the ordinary marine type containing about 1,400 square feet of cooling surface and furnished with circulating water by a 6-inch centrifugal pump driven by a 6-inch by 6-inch vertical engine. The air pump is a 6-inch by 10-inch by 8-inch of the vertical suction valveless type.

STEAM PLANT.

Steam is furnished by three boilers of the locomotive type, but having combustion chambers extending between the furnace and the tubes. The boilers are 5 feet diameter of barrel 7 feet 3 inches height in front and 18 feet 6 inches length. The furnaces are 5 feet long, combustion chambers 3 feet 3 inches long and



SUCTION FRAME FOR SAND DIGGING.

each boiler contains 104 tubes 2 1-2 inches diameter and 10 feet long. The total grate surface is 75 square feet and the total heating surface 2,400 square feet. The boilers are provided with shaking grates and are adapted for burning either coal or wood, but since the development of the Texas oil fields has provided a cheaper fuel near at hand, it is probable that oil will be used in the near future. One chimney only is used for the three boilers, but it is divided into three flues by plates extending the entire length, giving the effect of a separate chimney for each boiler.

In addition to the dredging and propelling machinery the boat will be fitted out very completely with electric lighting, evaporating and refrigerating plants, machine and blacksmith shops and machine tools. The lighting plant consists of an 11 K. W. multi-polar generator driven by a 7-inch by 7-inch vertical engine at 350 revolutions per minute, and will operate a searchlight of 4,000 C. P., two arc lights of 2,000 C. P. and about 60 incandescent lights distributed throughout the cabins, engine room, main deck and hold. The evaporator is capable of supplying 2,000 gallons of fresh water in 24 hours and will also furnish enough filtered water for all domestic purposes. The refrigerating plant is of the direct expansion system, and will cool a storage room of 500 cubic feet capacity and also sufficient drinking water for the crew. The ammonia compressor is 4 inches diameter and 5 inches stroke driven by a 6-inch by 5-inch vertical engine at 180 revolutions per minute.

The cabins are very commodious and besides furnishing accommodation for a crew of 30 men, will contain a large office, a spare state room for inspecting officers, bath rooms for officers and crew, cold storage room and large kitchen and mess rooms,

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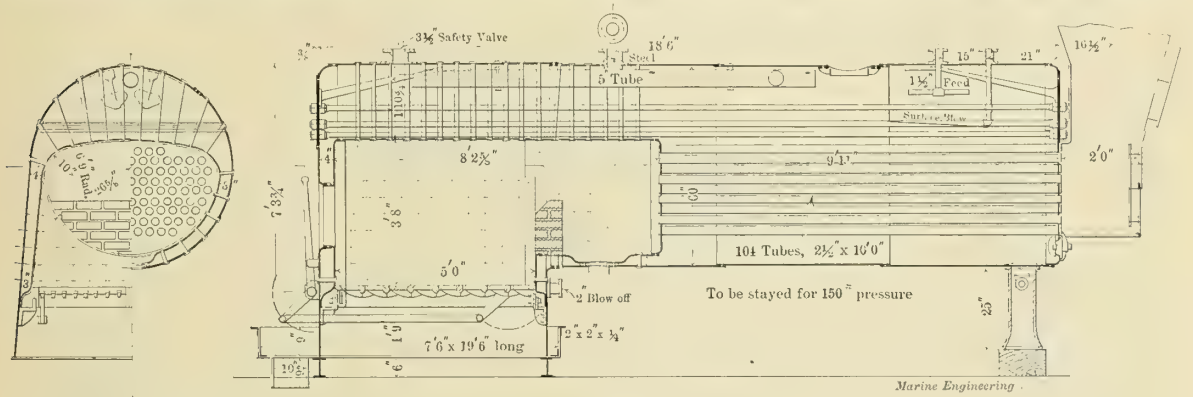
Torpedo Boat Builders.—The builders of torpedo boats and destroyers have appealed to the Secretary of the Navy for an increased payment over the contract price for these vessels, owing to the cost being so much greater than anticipated. The builders state that they have lost much money on contracts, and the total amount asked for is over $200,000. The Secretary has decided that he has no authority to pay this amount.

GERMAN EMPEROR'S YACHT METEOR III.

No launch within recent years has occasioned such universal interest as that of Emperor William's schooner yacht *Meteor*, launched from the yard of the Townsend-Downey Shipbuilding Company, Shooters Island, N. Y., on February 25th. This affair took on international importance because of the parties who participated in the ceremony. Miss Alice Roosevelt, daughter of the President of the United States, broke the bottle of champagne on the vessel's bow, and, in the name of His Majesty the Emperor of Germany, christened her *Meteor III.* The distinguished guests present included Prince Henry of Prussia, the Emperor's brother, President Roosevelt and many other distinguished men. The launching of this yacht was unique in many respects and was successful in every way.

The ways were laid with an inclination of 1 1-16 inches to the foot. The ground ways were 14 by 14 inches, and the sliding ways were 8 by 14 inches. The ways were laid with a distance of 13 feet 0 inches between centers. The yacht was started by a falling weight on each side knocking a dog shore out of position. The view on page 183 shows the general arrangement of the dog shores, weights, trips and trip line holding them. The trip line ran from the trip on one side of the yacht across the chopping block to the trip on the other side. Severing this line released both weights instantly. A detail of this is shown in Fig. 1. The weights were of lead, having a wrought iron hook, which caught the trip, and they weighed 360 pounds each. The safety batten was merely a small strip of 3 1-2 by 7-8 inches, nailed under the dog shore to keep it from falling out before the yacht was wedged up. When the weights fell they broke the safety battens, and, knocking the dog shores to the ground, released the yacht.



BOILER FOR LIGHT DRAFT DREDGE.

As the launching ways had an inclination of 1 1-16 inches to the foot, some method of checking the yacht's speed was deemed advisable. The checking was accomplished in two ways, and began to act practically as soon as the yacht was in motion. Her speed in sliding down the ways did not increase after she had gone ten feet, but continued nearly uniform, and after being water-borne she went less than 200 feet before she stopped.

The first method of checking was with two partial bulkheads, built across the cradle under the after

overhang, they were made of planks securely bolted to the aftermost poppets, and offered considerable resistance as soon as they struck the water. The second method of checking was with hawsers. A 7-inch hawser was run completely around the ship, about the low water level, forming a belt. This hawser was held in position by lines running up to the rail about every 20 feet. On each side an 8-inch hawser, secured on deck, came through the hawse pipe and was carried aft along the side, being seized to the belt hawser in five places, forming stops. To the ends of each of these 8-inch hawsers was fastened a 2,000-pound anchor buried in the ground. The weight of the yacht sliding down the ways was taken up by the stops, one by one. As the tensile strength of a stop was exceeded it broke and the strain came on the next one. Breaking these stops kept the yacht from obtaining an excessive speed. The foremost stop on both sides remained unbroken. This system of snubbing worked very successfully.

Being built in a shed, it was not possible to have any spars up. When the *Meteor* was christened and began her journey down the ways, not a flag was to be seen on board of her; yet when she flóated out into the stream, she seemed alive with bunting. A large American flag flew from her jack staff aft, a string of flags fluttered from stem to top of foremast, thence to top of main mast and down to the deck again. Old Glory was at the fore, while the German Standard was at the main, surmounted by the Kaiser's private racing flag.

The effect was very pretty and the way it was accomplished was very ingenious. The masts were raised automatically by loosening a rope from a cleat. The foremast was 40 feet long and the mainmast 50 feet; both were 7 inches diameter.

Fig. 2 gives a detail of the lower end of a mast, both masts being the same. The end consists of an 8-inch channel bar, bolted to the wood mast with four 3-4-inch through bolts. At the extreme end was 900 pounds of lead, which was lashed in place. Through the channel bar was a 1 1-4-inch diameter bolt, for the mast to turn on. The masts were held flat on deck by a rope wound round a cleat, and the flags were strung on while the masts were in this position. As soon as the yacht had slid clear of the building shed the masts were freed and immediately swung round till upright.

In her launching condition, the *Meteor III.* weighed 260 tons. The time consumed in launching her from the time the men began to drive the wedges till she was in the water, was just under eleven minutes. Her general dimensions are:

THE LAUNCHING OF EMPEROR WILLIAM'S YACHT METEOR III.

Length over all	161 ft. 0 in.
" water line	120 " 0 "
Beam molded	27 " 0 "
Depth "	18 " 6 "
Draft, extreme	15 " 0 "
Displacement, loaded	315 tons.
Freeboard at lowest point	4 ft. 0 in.
" " bow	10 " 0 "
" " stern	6 " 0 "
Bulwarks	2 " 4 "
Overhang forward	18 " 0 "
" aft	23 " 0 "

Her lead ballast will weigh 110 tons, 90 tons of which was on board when she was launched.

The *Meteor III.* has been built by the Townsend-Downey Shipbuilding Company under the supervision of Mr. Theo. E. Ferris from designs prepared by Messrs. A. Cary Smith and Barbey.

The yacht is built of Siemans-Martin steel through-

out, and the weights are so distributed as to give the greatest strength on the lightest scantling. The keel is a steel plate of trough section. The stem is made up of an angle shaped to the form of a hull, beveled to receive the plating and lapped over the keel plate. The stern post and rudder frame are of forged iron. The frames and reverse frames are of angles, the latter extending down to the keel. Beams of angle section are placed on all frames. The plating is laid in inside and outside strakes. There is a water-tight steel collision bulkhead forward and one aft of the forecastle, each containing a water-tight door. The bulwarks are 24 inches high above the deck and extend continuously fore and aft and carry a teak rail. The chain locker is located below the forecastle floor.

The yacht will carry two boats and a launch, to be swung on davits, and awning stanchions made of gas pipe will be fitted from stem to stern for stretching the awning when in port.

The spars are of the following dimensions:—

Mainmast, Oregon pine,	89 ft.	long	above deck,	21½ in.	diam.
Foremast, " "	86 "	"	" "	21 "	"
Main topmast, spruce,	64 "	"	about	13 "	"
Fore " "	59 "	"	"	13 "	"
Main boom, Ore. hollow,	84 "	"		18 "	"
Fore " spruce,	37 "	"		11 "	"
Main gaff, spruce, hol'w,	53 "	"		12 "	"
Fore " " "	36 "	"		9 "	"
Bowsprit, Oregon,	52 "	"		15 "	"
Spinnaker, spruce, solid,	68 "	"		10 "	"

Spare boom, Oregon pine.

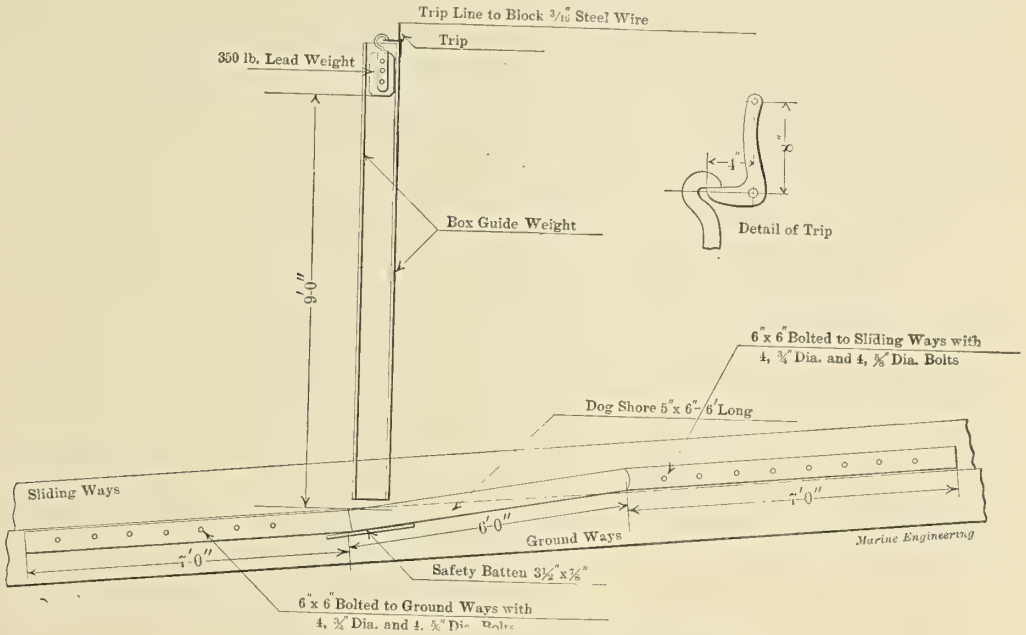


FIG. 1. DETAIL OF DOG SHORE AND WEIGHT.

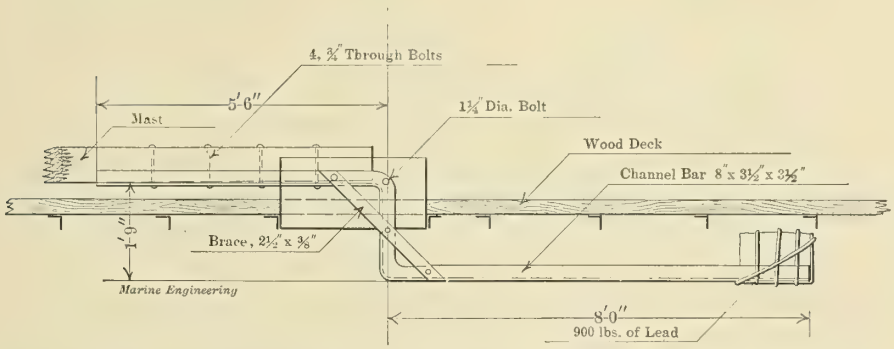


FIG. 2. DETAIL OF LOWER END OF MAST FOR THE LAUNCHING OF YACHT METEOR III.

The carpenter and joiner work are of the very best quality throughout. The deck is laid with 3 by 3 inch white pine. The companionways, skylights and ladders are made of teak, which is the wood used for finishing throughout. The deck fittings, cleats, etc., are to be of polished brass. A bronze capstan and the necessary bilge pumps will be fitted, and also a handsome hand steering gear with bronze and teak wheel.

New Electric Beacon. — The new electric beacon tested at Diamond Shoals, Cape Hatteras, threw the beam of light 23 miles.

THICKNESS OF PIPES.

BY WILLIAM BURLINGHAM.

The accompanying diagrams embody the formulae for the thickness of steam and feed pipes for marine work. The method shown is of general application and saves much time through its convenient form.

The formula plotted in diagram I is that used by the United States Supervising Inspectors of steam vessels and the Bureau of Steam Engineering. It is suitable for stationary engine work, and will pass all inspections.

The formula is as follows:—

$$T = \frac{P \times D}{8000} + .0625$$

Where T = thickness in decimals of an inch.
D = diameter of pipe inches.
P = pressure by gauge.

Tubes, water pipes and steam pipes made of Bessemer, acid or open hearth steel shall be required to show the following physical tests for use in the commercial marine:—

Elastic limit 30,000 to 35,000 pounds per square inch; tensile strength 50,000 to 60,000 pounds; elongation in 8-inch specimen 20 to 25 per cent; reduction of area 45 to 50 per cent.

The formula is for straight lengths of pipe only. A bent pipe should be made one gauge thicker than that given by the formula. It applies to straight copper pipes for steam, exhaust, bleeders, blow pipes, etc.

For feed pipes in ordinary commercial work, the formula on sheet No. 2 is required:—

$$T = \frac{1.25\ P \times D}{8000} + .0625$$

For navy work this formula as now used is

$$T = \frac{1.5\ P \times D}{8000} + .0625$$ shown on sheet No. 3.

For water pipes without pressure, P = 50 pounds.

For exhaust pipes 4 1-2 inches diameter and less, P = 20 pounds.

For exhaust pipes exceeding 4 1-2 inches diameter, P = 50 pounds.

Since the advent, during late years, of high pressure steam, it has become necessary to use steel steam pipes. The formula as used by the Bureau of Steam Engineering is as follows:—

$$T = \frac{P \times D}{10000} + .125.$$ See sheet No. 4.

To be one gauge thicker for bent pipes.

No bends must be made in copper pipes of which the radius is less than one and one-half times the bore of the pipe. Bends in steel pipe must be considered each case by itself. Copper and brass piping of 6 inches diameter and less should be seamless drawn; above 6 inches should be brazed. All steel steam pipes should be seamless drawn where practicable.

There should be no screw joints in steel steam piping. The joints will be made by flanges of stamped or forged mild steel of the same quality as specified for steel steam pipes. The pipe should be either welded to the flange or else rolled into the flange and beaded over to fit a recess, flush with face of the flange.

The inspection of copper used for the above pipe is as follows:

1. The pipe must be made of lake copper, and a chemical analysis must show that the metal is 99.5 per cent pure copper, one analysis being taken from each lot of 2,000 pounds or less.

2. The pipe must be free from indentations, cracks, flaws or other surface defects, inside and outside, perfectly round, of the specified diameter and thickness in all parts. All straight sections of pipe 6 inches in diameter or less (inside) shall be seamless drawn.

3. Each pipe must withstand an internal hydraulic pressure which will subject the metal to a stress of 7,000 pounds per square inch of section, the test pressure being calculated by the following formula for thin, hollow cylinders, but in no case will a test pressure of over 1,000 pounds per square inch be required.

P = safe internal pressure.
d = inside diameter in inches.
S = safe tensile strength of material.
(7,000 pounds per square inch.)
t = thickness of pipe in inches.

$$P = \frac{2\ t\ S}{d}$$

Every pipe must be perfectly tight under pressure and show no signs of bulging, cracks, flaws, porous places or other defects.

4. A strip 1 1-2 inches wide will be taken from each lot of 2,000 pounds or less of pipe, and must stand the following tests:—

(a) If less than 1-2 inch thick, it must stand bending flat back cold after being annealed.

(b) If 1-2 inch or over it must bend back after being annealed until the ends are parallel and the inner radius of the bend is equal to the thickness of the piece.

(c) In every case the ends of the bending test pieces shall stand hammering down hot to a knife edge, without showing signs of cracks.

5. Pipes of 2 inches inside diameter and over, for steam or feed pipes or other such high pressures, all to be subject to tensile tests; one piece of pipe from each lot of 1,000 pounds or less being selected to represent the lot. If the pipes are from 2 inches to 6 inches inside diameter, the test pieces are to be cut longitudinally. If over 6 inches inside diameter, they will be cut circumferentially. The test pieces will be heated to a cherry red and straightened when hot, then machined to the shape shown in sketch, care being taken to have the brazed seam,—if there is one,—between the measuring points.

6. For thicknesses up to and including 1-4 inch, the width of the narrow part of the test piece shall be about 1 1-2 inches. For thicker pieces the width shall be such as to give a cross section of about 1-2 square inch, but the breadth shall not in any case be less than the thickness. The rolled surfaces are not to be machined, but left in their original condition.

7. The test pieces must show an ultimate tensile strength after being annealed of at least 28,000 pounds

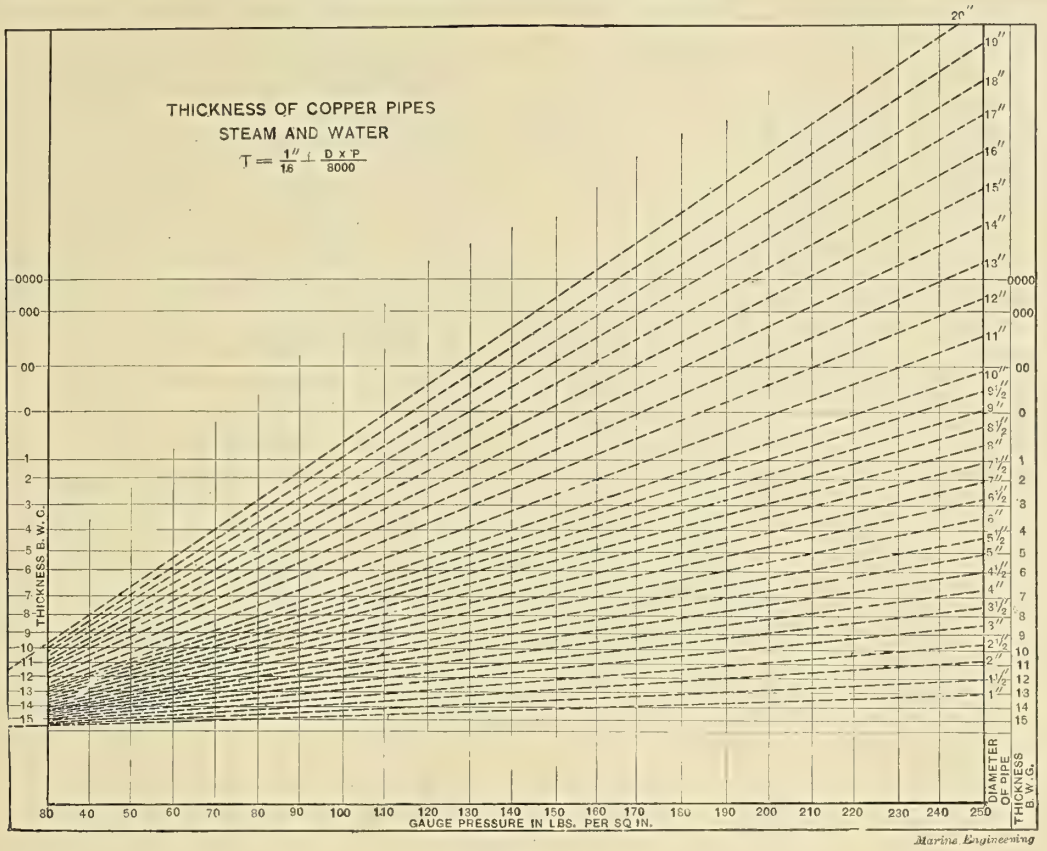

THICKNESS OF COPPER PIPES
STEAM AND WATER
$T = \frac{1''}{16} + \frac{D \times P}{8000}$
THICKNESS B. W. G.
DIAMETER OF PIPE
THICKNESS B. W. G.
GAUGE PRESSURE IN LBS. PER SQ IN.
Marine Engineering

FIG. 1.

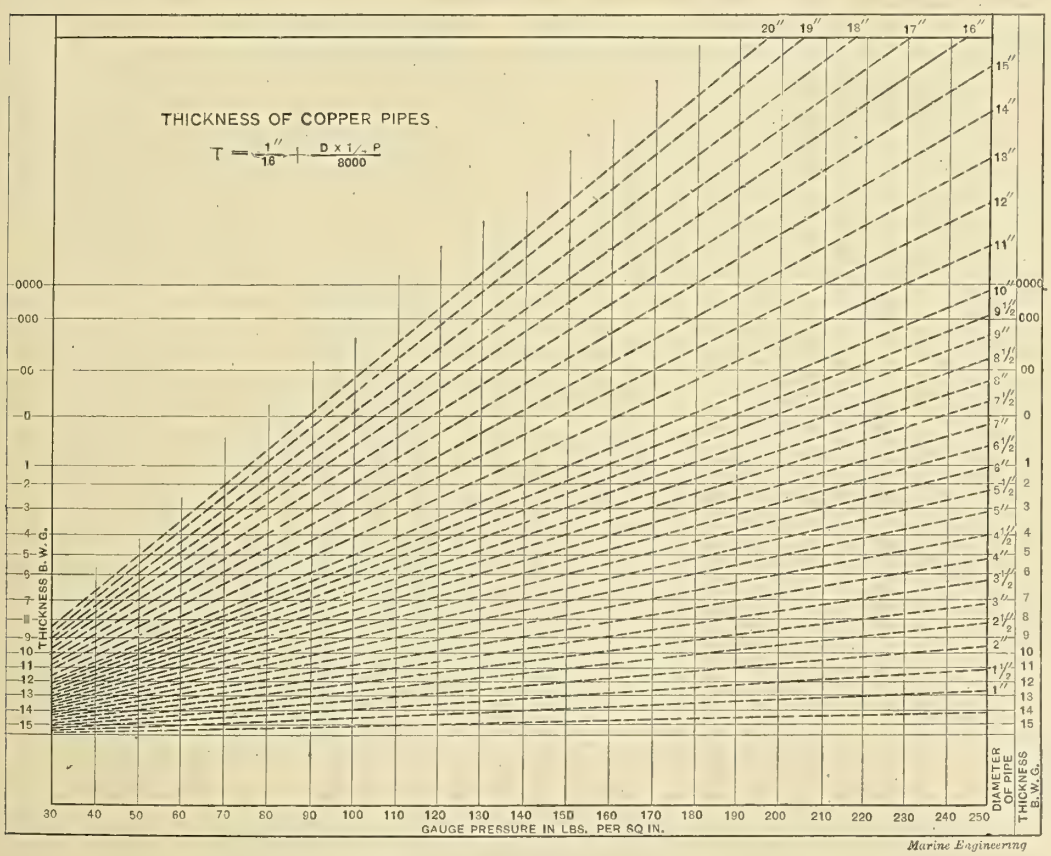

THICKNESS OF COPPER PIPES
$T = \frac{1''}{16} + \frac{D \times 1\frac{1}{2} P}{8000}$
THICKNESS B. W. G.
DIAMETER OF PIPE
THICKNESS B. W. G.
GAUGE PRESSURE IN LBS. PER SQ IN.
Marine Engineering

FIG. 2.

per square inch for all pipe, and an elongation of at least 25 per cent in 8 inches in the case of seamless pipe.

8. Every pipe must be of the specified thickness in the thinnest part. The tolerances for excess of thickness will be allowed as follows:—

Pipes up to	15	B. W. G.	.....	12	per cent.
15 "	12	"	.....	10	"
12 "	9	"	.....	8	"
9 "	7	"	.....	6	"
7 "	00	"	.....	5	"

9. The weight of every pipe must be at least equal to the calculated weight, assuming 1 cubic inch of copper pipe weighs 0.320 pound. An excess weight equal to 5 per cent of the calculated weight will be allowed.

For merchant work, all steam pipes of iron or steel, when lap welded by hand or machine, with their flanges welded on, shall be tested to a hydrostatic pressure of at least double the working pressure of the steam to be carried, and properly annealed after all work requiring fire is finished.

For naval work, steel steam and water pipes, seamless and lap welded.

1. Material. (a) The seamless pipes must be made from solid billets or disks of perfectly homogeneous steel, and cold drawn or hot rolled, as specified in the order.

(b) The lap welded steel pipes must be made of steel of a homogeneous quality, and of the grade which is found to insure the soundest welds. The skelp must be rolled true to gauge.

2. Surface Inspection. The pipe must be free inside and outside from all surface defects which would materially weaken it or form starting points for corrosion. The defects in seamless tubes to be especially avoided are: tears, snakes, checks slivers, scratches, laps, pits, rings and sinks, and in lap welded tubes defective welds, cracks, blisters, scale pits and sand marks. The pipe must be perfectly round and vary not more than one per cent above or below the gauge.

3. The following tolerances will be allowed below the specified thickness:

Pipe of all diameters not over 3 inches outside diameter, tolerance 0.01 inch below.

Pipe 3 inches to not over 5 inches outside diameter, tolerance 0.02 inch below.

Pipe 5 inches to not over 7 1-4 inches outside diameter, tolerance 0.03 inch below.

Pipe 7 1-2 inches and over, 0.06 inch below.

4. Weight. The weight will be calculated from the specified dimensions and thickness, assuming that one cubic inch of steel weighs 0.283 pound. A tolerance of 3 per cent under and 7 per cent over weight will be allowed for all pipe over 4 inches in diameter, and a tolerance of 3 per cent under and 5 per cent over weight will be allowed for pipe 4 inches outside diameter or less.

5. Hydraulic Test. Every pipe must be subjected to an internal water pressure of 1,000 pounds per square inch without showing signs of bulges, cracks or other defects.

6. Other Tests. Pipe 4 inches outside diameter and less will be tested in lots, and in the same manner as prescribed for steel boiler tubes. Pipes over 4 inches outside diameter may be tested in lots of 10, four pipes being selected from each lot, and care taken that the pipes selected for tests have had the same treatment as the remainder of the lot, i. e., that they must not be annealed or softened by slow cooling unless the others have been treated in the same way. If the inspector has any doubt that the pipes have all received the same treatment, he will test each pipe singly.

(a) Two test pieces will be cut circumferentially (when it is practicable to get a strip of the requisite length) from the ends of two different pipes, straightened when hot, and machined to shape and to a width of 1 1-2 inches. For thickness up to and including 5-16 inch, the length between the measuring points will be sixteen times the thickness. For thickness greater than 5-16 inch the length between measuring points will be 8 inches. In the case of welded pipe, the test piece must be cut so as to leave the weld in the middle. The test must show a minimum tensile strength of 48,000 pounds per square inch, and an elongation of at least 12 per cent in 8 inches, or 15 per cent in 5 inches.

(b) Two test pieces of a width equal to three times the thickness of the metal in the pipe cut circumferentially from the ends of the other test pipes, so as to include the weld, if any, shall stand bending cold at the weld to an inner diameter equal to thrice the thickness of the metal without showing cracks on the outside of the bend.

7. The failure to pass these tests in a satisfactory manner will reject the lot, unless the manufacturer desires to test each pipe separately, in which case a tensile test shall be taken from one end and a bending test from the other, and the pipe accepted or rejected accordingly.

8. If the ends of the pipes are flanged, swaged down, swelled, upset or reinforced, they will be inspected after this work is done, to see that no damage has been done by this process.

9. All cold drawn pipes must be annealed in retorts or in an improved furnace in which the flame does not strike them.

Steel Flanges for Steel Pipe. The flanges are to be forged from the solid (not welded), and are to be screwed, riveted or welded on as required by the order.

The steel of which flanges are made shall stand the following tests: The test piece to be taken from the billet or plate from which the flange is forged, and to be reduced to shape with the least amount of hammering possible. One tensile test piece and one bend shall be taken from each lot of 1,000 pounds or less.

The test shall show that the metal has a tensile strength of at least 56,000 pounds per square inch and an elongation of at least 30 per cent in 2 inches. The bending test piece 1 1-2 inches wide shall stand bending double (until the ends are parallel) without fracture (on the outside of the bend) to a curve, of which the inner radius is one and one-half times the thickness of the test piece.

Names of Masts.—The names for the seven masts of large schooners now building have been designated as follows: Fore, main, mizzen, spanker, jigger driver and pusher.

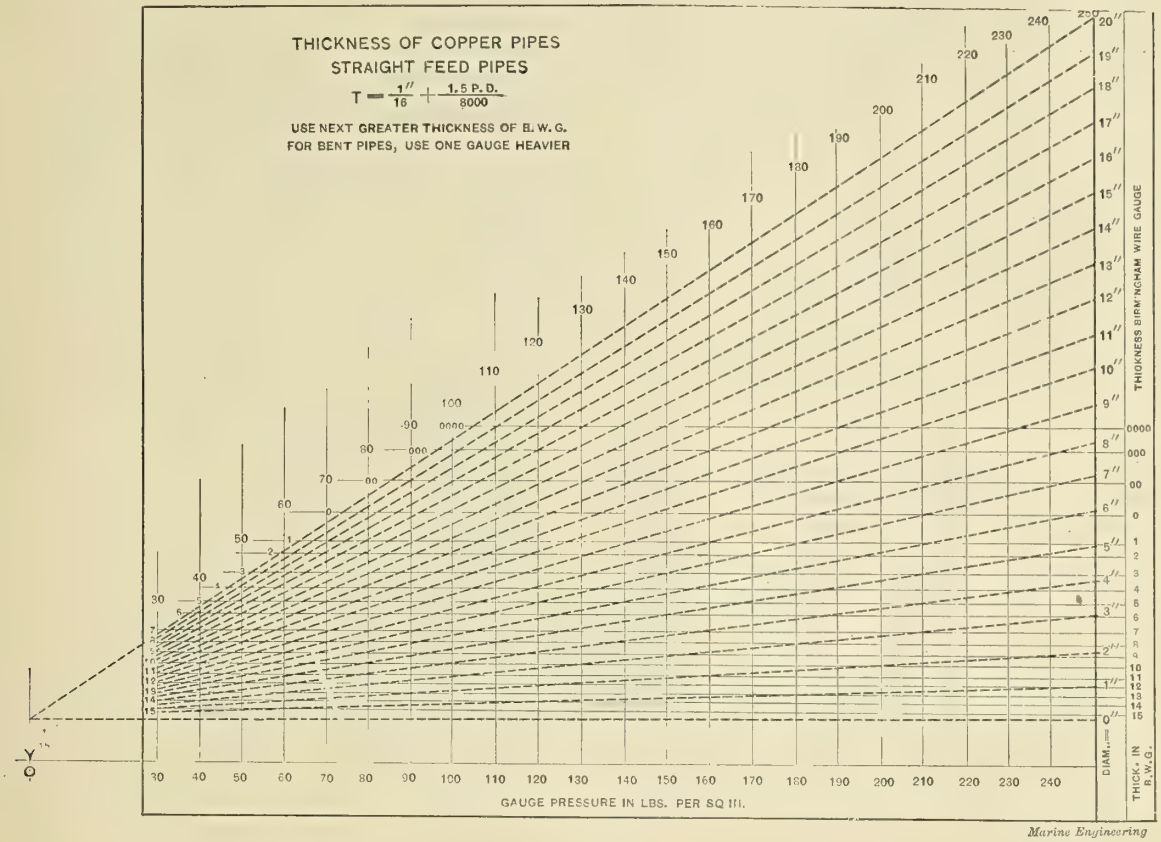

THICKNESS OF COPPER PIPES
STRAIGHT FEED PIPES
$T = \frac{1''}{16} + \frac{1.5\ P.\ D.}{8000}$
USE NEXT GREATER THICKNESS OF B. W. G.
FOR BENT PIPES, USE ONE GAUGE HEAVIER
GAUGE PRESSURE IN LBS. PER SQ IN.
DIAM.
THICK. IN B.W.G.
THICKNESS BIRM'NGHAM WIRE GAUGE
Marine Engineering

FIG. 3.

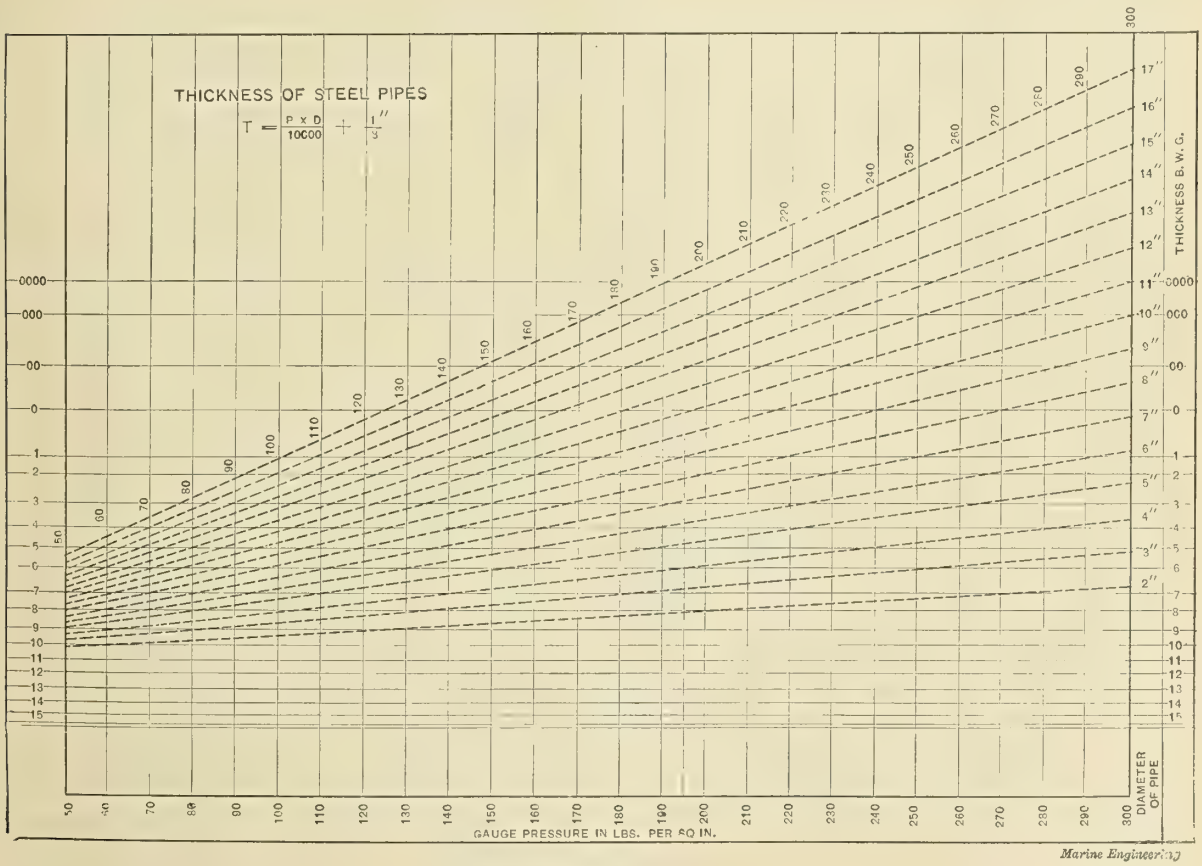

THICKNESS OF STEEL PIPES
$T = \frac{P \times D}{10000} + \frac{1''}{8}$
GAUGE PRESSURE IN LBS. PER SQ IN.
DIAMETER OF PIPE
THICKNESS B. W. G.
Marine Engineering

FIG. 4

Marine Engineering

Published Monthly by

MARINE ENGINEERING,
INCORPORATED

309 Broadway - - - New York.

H. L. ALDRICH, President and Treasurer.

PROF. W. F. DURAND, Advisory Editor.
F. D. HERBERT, Associate Editor.
G. SLATE, Advertising Representative.

Branch Offices.

Philadelphia, Pa., Mach'y Dept., The Bourse, S. W. Anness.
Detroit, Mich., Hodges Building, L. L. Cline.
Boston, Mass., 170 Summer St., S. I. Carpenter.

TERMS OF SUBSCRIPTION.

	Per Year.	Per Copy.
United States, Canada and Mexico	$2.00	20 cents.
Other countries in Postal Union	2.50	25 cents

Entered at New York Post Office as second-class matter.

Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE proposition of Rear Admiral George W. Melville to establish at Annapolis a laboratory for engineering research, modelled somewhat after the German governmental laboratory at Charlottenburg, Berlin, is one in which all engineers must take a deep interest. The spirit of investigation and research represents the attitude of the present age toward the great problems involved in scientific and engineering progress. Now, as never before, it is realized that these problems cannot be solved by any process of abstract reasoning. Nature will reveal her secrets only to him who asks, and who asks in the right manner; and it is undoubtedly true that progress in industrial matters is in a very real manner dependent on the extent to which we interrogate nature persistently and properly regarding the problems with which we are concerned.

Admiral Melville finds in the experimental station at Charlottenburg in part, an explanation of the recent rapid advance of the Germans in industrial lines, and of their having outstripped their competitors in so many branches of industrial work.

The Admiral also points out that at the Naval Academy, where officers are trained for engineering service in the navy, the facilities for experimental work and for laboratory instruction are inferior to those which can be found in several of the leading technological schools of the country. In discussing the proposition, the statement is clearly made that several institutions in the country are turning out better engineers than the Naval Academy, with its present curriculum and equipment, and that when the Government is engaged in rebuilding and re-equipping the Academy at a cost of about $8,000,000, a feature of such great importance and of such real necessity should not be omitted from the program.

To this end an appropriation of $400,000 is asked to inaugurate the plan. An officer has also been recently sent on a tour of inspection among the leading technological schools, and much valuable information has been gathered which will be of the greatest aid in inaugurating a project of this character. The experiences of others in dealing with similar problems will thus become available, and it may be sure that the appropriation asked for will be expended in the most efficient possible manner.

We earnestly hope that Congress will look with favor on this proposition of Admiral Melville's, and that it will promptly grant the appropriation asked. With such an amount a good start can be made, and the main feature of the comprehensive plan can be well outlined. It is to be hoped, however, that the start which might be thus made will be followed up with liberal appropriations, so that further extension and development may be carried on along the many lines of usefulness which will appear as time goes on. The money which is being spent in the rebuilding of the Naval Academy is a large sum, but we are glad to see public money spent for so worthy a purpose. The Government is able to pay for the best, and it should have it. With such a general scheme, however, we believe most strongly with Admiral Melville, that an experimental engineering station is a most appropriate and necessary feature. We believe, furthermore, that from no other feature of this great enterprise, will the engineering public receive such direct benefit as from this. The questions which concern naval engineers concern also marine engineers in general, and engineers of all classes in more

or less direct manner. The freedom with which the Bureau of Steam Engineering has always given information and data to the engineering public, and the readiness which they have always shown to help along in every possible way the engineering fraternity, shows that such an experimental establishment under the control of this Bureau, would be administered for the good, not only of the Naval Service, but so far as possible for the aid and advancement of engineering science and art in their broadest aspects.

In no other way can Congress, in our opinion, accomplish with so modest an investment so much for the industrial advancement of our people, and we would call this opportunity most earnestly to the attention of our representatives, and urge in behalf of our industrial and engineering interests in their widest aspects, that this proposition of Admiral Melville's be considered favorably, and a start thus made toward the establishment of an experimental station, in which we shall, as engineers and as American citizens, be able to take a just pride.

THE present industrial situation as regards the market for shipbuilding material is of interest in connection with the influence which this condition exercises on usual methods of design and construction. Any problem involving the use of structural material, must be studied well, not only with reference to the questions usually involved, but also with reference to the supply of material likely to be found available.

In particular, all designs should be so schemed out as to avoid the use of special forms or sizes. It is hard enough to obtain regular and standard forms and sizes, and next to impossible to obtain "specials." Where time is of importance these considerations may even justify some departure from the character of design which would be dictated by engineering principles pure and simple. The question as to the extent to which such considerations should be allowed to modify the best engineering practice is one which judgment alone can determine. The practical engineer soon learns, however, that engineering is not all based on mathematics and mechanics and the laws of physical nature. He soon learns that ideal engineering can rarely be realized, and that he must continually depart from such ideals in order to realize the best all around result from the business and administrative standpoint. At no time has the demand been greater for a full realization of these facts or for a full and careful study of all such general considerations than the present.

Now, as never before, will careful study of these problems of design be found needful, and we would recommend time spent in such study as of the highest importance and as sure to bring a manifold reward.

WE are sure that our readers have received much valuable instruction and many useful hints from the series of articles on breakdowns, accidents and repairs which we have been publishing for some months, and we are desirous of continuing this series, and hope that all who may have had experiences which they believe might be helpful to others will send us their contributions.

We wish, furthermore, to extend the scope of these articles to include the modern type of marine gas engine. The small gas engine motor in its various forms is a most important factor in modern launch and small boat construction, and the extent to which it is at present in demand for such purposes would hardly be realized by those unfamiliar with the trade situation. We are now approaching the season for small boats and pleasure craft, and the use of motors of this general type seems to be likely to become more and more common. From the very nature of the case they are often or even commonly in the hands of those with little or no training as engineers, and there is, therefore, the more need for plain and simple directions for the operation of such machinery and for coping with the troubles which more commonly arise. For the latter there is no teacher like experience, and for this reason we wish to provide the means for an interchange of ideas and experiences in connection with motors of this type, especially as regards troubles, derangements, breakdowns, etc. We, therefore, especially ask all those who may have had experiences with such motors, which they believe will be of use to others, to send us their communications and thus aid in familiarizing the public with the best methods of operating machinery of this popular type.

MISHAPS AND REPAIRS.

Thrust Shaft Repairs.

Today, when forgings, no matter how mechanically intricate, are readily manufactured, it is seldom that one runs across a built up thrust shaft.

The thrust shaft which forms the subject of this article is in a British built vessel, now running to South American ports from New York. The engines were built at Glasgow, in 1888, by John and James Thompson, the cylinders being 25 inches, 41 inches and 67 inches by 42 inches stroke.

The thrust shaft originally consisted of the wrought iron shaft proper, and the halves bearing the collars, these halves being cast iron. The halves were held together by four 1 3-4 inch fitted bolts, and one iron ring shrunk on to the middle collar. Shoulders at the end of the thrust halves on the shaft prevented end play. It will be noticed in the drawing, which shows how the shaft looked after the repairs were made, that these fitted bolts passed through lugs cast on the thrust halves. These lugs, when the shaft was revolving, would churn the lubricant (a mixture of oil and water) and would throw it out of the thrust block, and to prevent a waste of money, oil was dispensed with and water only used.

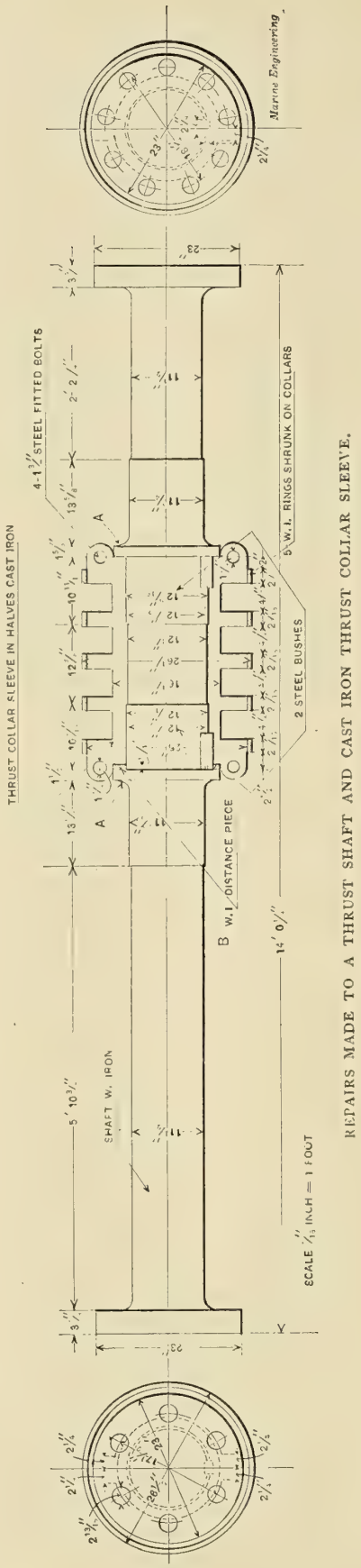
After running nearly thirteen years, the chief engineer complained of his thrust, saying that the shafting had nearly one-half inch end play, which naturally brought a strain upon the connecting and piston rods, by throwing them out of the center line, and even more, brought a severe strain upon the top and bottom end bolts. So it was decided to overhaul the thrust, and accordingly the bolts holding the halves together were driven out, and the wrought iron ring removed. When the cast iron halves were away, it was found that the portion of shaft between the two shoulders, A and A, was deeply corroded, that the keys were also quite gone, and that apparently the only thing which was still in good order was the middle part of the shaft, where the halves had been pressed to the shaft by the wrought iron ring.

The shaft and halves were taken out and sent to the shop, and how the repairs were made is readily seen from the drawing.

The shaft, in the corroded part, was turned down from 12 1-2 inches to 12 9-32 inches, thus leaving it bright and removing the corroded portion. The thrust halves were also bored out 1-16 inch larger for part of their length. New keys, 1 1-8 by 2 1-8 inches, were put in, and the distance gained by facing up the shoulders, A and A, was taken up by a 11-16 inch distance piece. Two steel plates, 9-32 inch thick, were rolled out and put into place on the shaft, the halves bolted on, and then to make the job solid, 5 rings, 3-4 inch thick and 2 3-16 inches wide, were shrunk on, with an allowance of 1-32 inch wide for shrinkage. The whole shaft was then put into the lathe and the thrust part trued up.

This shaft, in its way, is a curiosity nowadays, when few builders would go to the expense of making a built up thrust, to say nothing of the increased expense of this shaft over one of more recent practice.

It appeared to me at the time the repairs were made that the bolts would be unnecessary, and that


Marine Engineering
4-1¾" STEEL FITTED BOLTS
5 W.I. RINGS SHRUNK ON COLLARS
THRUST COLLAR SLEEVE IN HALVES CAST IRON
2 STEEL BUSHES
B W.I. DISTANCE PIECE
SHAFT W. IRON
SCALE ½ INCH = 1 FOOT

REPAIRS MADE TO A THRUST SHAFT AND CAST IRON THRUST COLLAR SLEEVE.

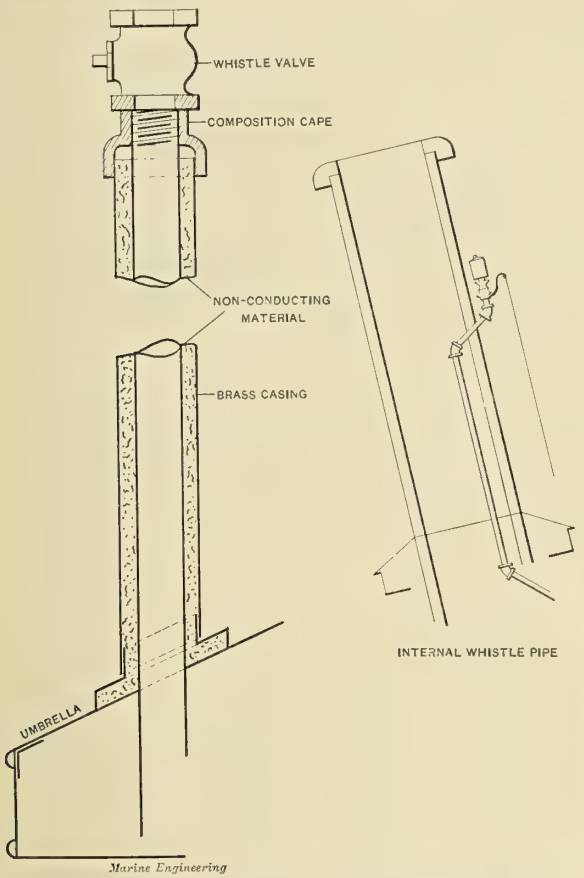
the lugs could be removed, depending solely upon the shrunk-on bands to hold the halves together; but in marine engineering we find that men are very much averse to experiments, and are well content to leave good enough alone.

If these lugs were removed it would be difficult to tell this built up thrust shaft from one of the ordinary kind, and the cause of throwing the lubricant from the thrust bearing would be removed.

D. E. F.

Troubles with a Whistle.

A whistle is a very important thing on a steam vessel. When it works well it is no trouble, but when it gets out of order and leaks, or shoots out about a barrel of water every time the rope is pulled, then is when the engineer's trouble begins.



TWO METHODS OF KEEPING A WHISTLE PIPE FREE FROM WATER.

In the summer of 1899, I was serving as First Assistant Engineer on a 1,500 ton steamer that had recently been cruising in the tropics. Nothing of any account happened to this particular whistle until we made a trip into Alaskan waters, where it is pretty cold weather, even in the summer time. As soon as we got north of Vancouver Island, it was noticed that quite an amount of water would blow out through the whistle before any sound was produced. This state of affairs annoyed the deck officers as they did not relish the idea of getting an involuntary shower bath every time it became necessary to sound a signal. The trouble became aggravated by the whistle valve beginning to leak and constantly dripping water around the deck. The Captain insisted that something should be done to stop this annoyance, so the only thing was to take the whistle down and re-grind the valve. In port this would be a comparatively easy undertaking, but to handle a whistle with a 10-inch bell, weighing 125 pounds, while swung up in a boatswain's chair, with the ship rolling and pitching alternately, is no easy matter. However, it was finally taken down, the valve removed, the seat re-ground, and the whole business put back in place again.

This stopped the leak temporarily, but it still acted like a geyser every time it became necessary to blow. After we got into Sitka we determined to try and put a stop to this blowing of water. Consequently the Chief Engineer decided to put a ½ inch drain pipe connected to the lower part of the operating valve and leading down to the feed tank to save the water. A valve was put into this drain pipe within convenient reach of the quartermaster, so that he could open the drain at intervals, and remove the water. The assumption was that the whistle pipe, which for a length of about 15 feet was exposed to the atmosphere, was acting as a condenser, and thus causing all the rush of water. Thinking now that all of our whistle troubles would be over, we anxiously awaited the time to give the new draining apparatus a trial. This came soon on our run from Sitka to Juneau. We tried the drain, and we tried the whistle. The latter still squirted out water. In addition to that the old operating valve began to leak again.

Arriving at Juneau there was nothing to do but regrind the operating valve once more. This was done, and, under test, it proved to be tight again. We stopped in Juneau two or three days, and the engineer's force had a little rest from whistle repairs. We left Juneau at about half-past ten one evening, and as it was in the month of June it was still almost light enough on deck to read a newspaper. A number of people had gathered on the wharves to see us depart, and out of compliment to them the Captain decided to give them three blasts from our old friend, the whistle. The quartermaster yanked the rope and she blew; she also continued to blow with the wildest and most wierd shriek ever heard from a steam vessel. The noise was almost deafening—no orders could be heard, and still the shrieking continued.

Finally, by pantomimic signals, the order was passed to shut off the stop valve on top of the boilers. This was quickly done and everybody breathed sighs of relief. An investigation of the whistle valve was made, and it was found that the valve and its stem and the cover had disappeared. There had been such a rush of water when the rope was pulled that it had stripped the threads off the cover, and the inner workings of the valve had taken a sudden rush off into space. The good people of Juneau are probably not yet aware of the significance of the parting salute given them that evening.

As we were underway when the accident happened, it was decided to go right along to Skagway without a whistle. How to repair the old whistle valve or

obtain a new one was, as can well be imagined, a problem. Stores where 1½ inch whistle valves can be purchased in Alaska are as scarce as the traditional hen's teeth. Luckily the White Pass railroad, running into the Klondike, had just commenced operations that summer, and through the courtesy of the master mechanic, we were loaned an old locomtive whistle which, fortunately, was fitted for a 1½ inch pipe connection. We used this whistle during the entire trip, and it certainly sounded strange to hear a locomotive whistle echoing through the hills and mountains as we would go through some narrow strait on the inside passage. One of the officers said that every time he had heard it he felt like diving into his pockets for a railroad ticket.

A new whistle valve was purchased in Seattle, and the old whistle was fixed up again. We made a return trip to Alaska, this time going as far north as Cape Nome. The whistle continued to give us trouble, and we experimented all sorts of ways to stop the rush of water but with no good result. The whole trouble came from the fact that the whistle pipe connected to the steam pipe leading to the forward steam heaters and to the steam windlass. In cool weather all the water that had collected in this entire system would rush up the whistle pipe as soon as the valve was opened. The difficulty was finally overcome by running a drain pipe from the lowest point in the forward auxiliary steam pipe to the feed tank, and putting a good steam trap in the pipe. If I had the arrangement of a steam pipe to a whistle, I would be guided by either one of the following two precepts, or, perhaps, it would be better to heed both.

1. Do not connect the whistle pipe to any other steam pipe or system of pipes, but lead it from the boilers direct.

2. Lead it up inside of the smoke stack until it is at the height of the whistle, and then lead it through the inner and outer stacks at an angle of 45 degrees. If this is impossible, by all means as an alternative, cover it with a good nonconductor, and put a neat brass casing around the magnesia (or whatever is used) as shown in the sketch.

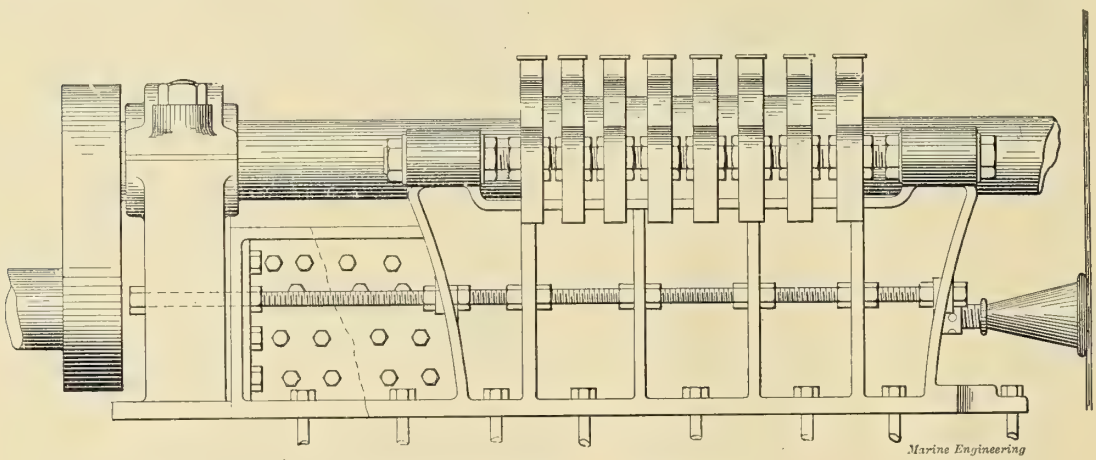
C. A. Westover.

Repairing Thrust Foundation.

The steamship *C. N.*, while entering Honolulu Harbor, H. I., picked up a line in her wheel while backing, which in a very short time slowed the engines.

The throttle was shut, but before she came to rest a loud crack was heard in the vicinity of No. 6 journal. On investigating we found the well connecting the thrust with the engine bed was cracked clear across and open 1-16 inch, the wood seating allowing the thrust to move back. There were no shops at Honolulu where we could go for repairs, so we had to do the best we could ourselves. We secured two plates 14 by 12 inches by ½ inch thick, and turned a 3-inch foot at one end, then drilled four 3 1-4 inch holes in the foot and fifteen holes in the body of the patch. It will be seen from sketch that the foot holes were there originally to bind the thrust to the engine bed, thus making the bed and thrust one solid piece.

The holes forward of the break in the casting were laid off and drilled from the plate when the foot was bolted in place, then a 1-32 inch piece of yellow metal was slipped under the foot and the remaining holes laid off and drilled. The yellow metal was then removed and the foot bolts pulled home. Then the 3-4 inch bolts were fitted, and the harder you got them the nearer the break came together.



METHOD OF REPAIRING A THRUST BLOCK.

The jack shown in the sketch was placed against an iron bulkhead conveniently near, and the thrust bearing was sent home, closing the breaks. The jack was left there as a precaution more than anything else, to take part of the load off the patches when the engines were backing. Before we left port the engines were worked full ahead, then full astern. Of course, the tendency was to close the breaks when the engines were going ahead, but the break remained the same when backing up.

We continued our voyage home to San Francisco, 2,100 miles, without any bother whatever, and on arriving the jack was supplemented by a through 1½ inch bolt passing through each rib, and jam nuts fitted as shown in sketch. This occurred in March, 1900, and the ship is still wearing the same patches and running all the time.

J. W. H.

ENGINEERS' DICTIONARY, XXXV.

Pitch. The term *pitch*, as applied to bolts or rivets, refers to their spacing, or distance between centers. Thus the stud bolts for securing the cylinder head to the cylinder may have a pitch of 5 inches, meaning that they are spaced 5 inches between centers. Or, similarly, the rivets in a boiler seam may have a pitch of 3 inches, meaning that they are spaced 3 inches between centers.

The term *pitch*, as applied to screw threads, means also their spacing or distance from one to the next. Thus a pitch of 8 threads to the inch means threads spaced 1-8 inch apart, or 8 complete turns of the thread in a length of one inch.

The term *pitch*, as applied to the screw propeller, has a similar meaning. Considering each blade of the propeller as a small part of the helical surface of a screw thread, the pitch is the longitudinal distance between two successive parts of the same spiral, supposing that it were extended round and round like an ordinary screw thread. Or, again, considering the pitch of the screw thread of a bolt from a different point of view, it may be defined as the distance which the bolt would move longitudinally for one complete revolution, supposing it to work in a fixed nut. Similarly the pitch of a propeller may be defined as the distance which the ship would move for one complete revolution of the propeller, supposing the latter to work on a smooth unyielding surface similar to that of a stationary nut.

Plunger. The piston in the water cylinder of a pump is often called a plunger. The term was formerly applied more especially to the moving part of a *plunger pump*, which see below.

Plunger Pump. A pump with parts arranged as shown in the figure. AB is the plunger, or moving part, which in this case is hollow or of the "trunk" form, and is operated by a connection at C.

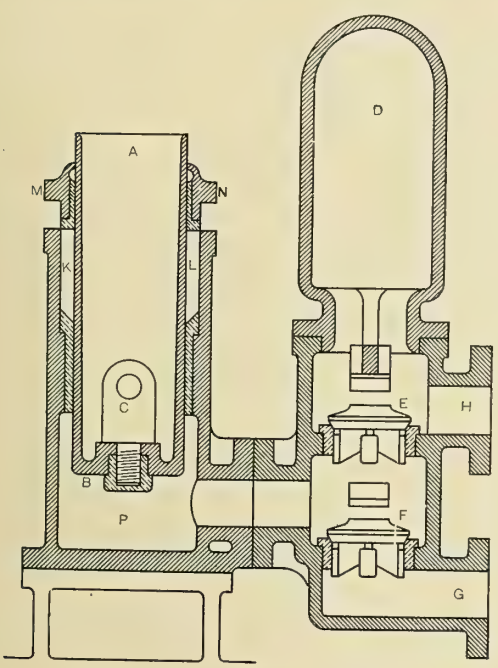


FIG. 98.

At KL is a packing space which is filled with elastic packing set up by the gland MN. In this way a tight joint between the plunger and the cylinder is formed. This is the only joint of the kind about the pump, and is always accessible for examination and adjustment. This fact gives to this type of pump one of its chief advantages. As the plunger rises the water flows in through the inflow pipe G, and valve F, to the pump cylinder P. On the down stroke the valve F closes, and E opens, admitting the water to the outflow or delivery pipe H. The air chamber D is fitted as usual on such pumps for absorbing the shock of sudden movements of the plunger, and to insure a greater uniformity of flow in the delivery pipe. Boiler feed pumps, when attached to the main engine, are usually of the plunger type, and in marine practice this forms the chief use for such pumps.

Port. An opening or passage for the flow of a vapor, gas or liquid from one chamber to another, and usually uncovered or covered by a slide valve of some type. The opening which thus admits the steam from the steam-chest to a cylinder of a steam engine

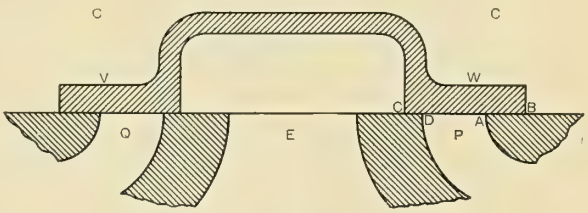


FIG. 99.

is known as the *steam* port. The opening by which the steam escapes to the exhaust pipe is known as the *exhaust* port. Thus the opening DA, controlled by the face BC of the slide valve, is a steam port providing, alternately, for the inflow of steam from the steam chest around the valve, and for its outflow to the space underneath the valve, whence it escapes to the exhaust pipe by the exhaust port shown in the middle.

Pressure-Gauge. An instrument for measuring or indicating the pressure, per square inch, in a boiler or other chamber containing a liquid, vapor or gas under pressure.

The most common type of pressure gauge is that employing what is known as a *Bourdon tube*. A gauge of this type is shown in the figure, with the tube bent in a nearly circular form as shown. The cross-section of this tube is elliptical, or oval, as shown in the small diagram, and the tube is so placed that the longer axis of this ellipse is at right angles to the plane of the figure, or to the plane of the tube. When the inside of the tube is subjected to pressure, the cross-section tends to open out and become circular in form, and as a consequence of this the tube, as a whole, tends to straighten out. This carries the free end outward, and this by means of suitable connections, as shown in the figure, is made to give motion

to the gauge pointer, the end of which swings over a suitable scale on the face.

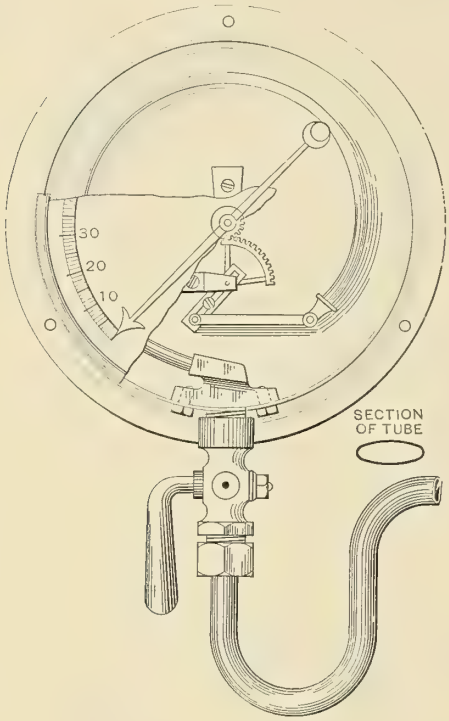


FIG. 100.

Pricker Bar. One of the tools used in caring for the fires in a boiler. It consists of an iron bar of suitable length, turned with a loop for a handle at one end, and with some 5 to 7 inches at the other end, turned at right angles, flattened down and drawn to a blunt point. It is used chiefly below the grate for clearing out ashes and refuse between the bars, and for brightening up the fire in this manner.

New Cunard Liner.—Press dispatches from England state that the Cunard Company have placed an order for a new transatlantic steamship for the New York mail route. The ship is to exceed all others in this service in speed and size.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports forty-six vessels of 8,607 gross tons built in the United States, and officially numbered during the month of February, 1902. The largest steel vessel included in these figures is the ship *Atlas*, 3,381 gross tons, built at Bath, Me., for the Standard Oil Company.

Coal Consumption of Turbine Steamers.—It is reported that the turbine steamer *King Edward* burned 1,429.8 tons of coal, and covered 12,116 miles during the last season, thus averaging 8.47 miles per ton of coal. In comparison to this the paddle steamer *Duchess of Cornwall*, of about the same dimensions and of the same type, consumed 1,758.7 tons of coal, made 15,604 miles, or averaged 8.87 miles per ton. The speed of the *King Edward* was 18.5 knots, and of the *Duchess* 16.5 knots.

TROUBLES WITH BRUSHES ON ELECTRIC MACHINERY.

BY WM. BAXTER, JR.

If a generator or a motor is properly proportioned the brushes will set diametrically opposite if it is a two pole machine, and one quarter of the circumference apart if it is of the four pole type; while for any greater number of poles the distance between the brushes will be equal to the circumference divided by the number of poles. In every case, however, all the brushes must be equidistant from each other. If the configuration of the field and the poles of a machine is not symmetrical, the position of the brushes that will give the best results, as to voltage and sparking, will not be that of equal distance between them. Cases of this kind will not be considered in this article, because at the present time there are few if any manufacturers who are so ignorant of the principles upon which electrical machines act as to produce designs that are so distorted as to require that the brushes be set out of the true position.

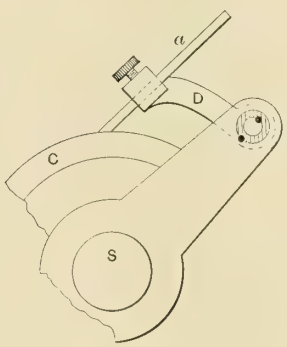


FIG. 1.

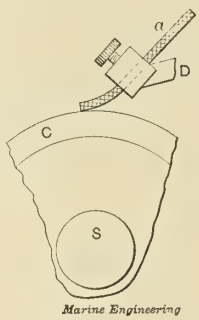


FIG. 2.

Although greatly distorted designs are not frequent in these days, it is still a fact that many machines are made in which it is the easiest thing imaginable to get the brushes out of place, and a decidedly difficult matter to set them properly. As an illustration take Fig 1, which shows a form of brush holder which, more or less modified, is extensively used. As will be seen from the diagram, if we have a two pole machine with brushes of this type, it will not be possible to have them resting on points diametrically opposite on the commutator surface, unless the angle the brush *a* makes with the commutator surface, is the same for both brushes; and as the two are on opposite sides of the shaft it is not an easy matter to determine by simple inspection whether the angles are equal or not. The point can be determined, however, by making a sheet metal gauge that will reach from the stud around which the brush-holder swings to the end of the brush. It may be well to observe that this gauge cannot be applied while the machine is running, as in such an effort there is danger of making a contact between the rocker that holds the brush and the commutator surface, or some other part that is in the circuit.

Brush holders of the type illustrated in Fig. 1 are, as a rule, supported upon a stud, around which they swing, as is shown in the illustration. The necessary

tension with which the brush presses upon the commutator is obtained by means of a spring, one end being connected with the brush holder D and the other with the stud upon which it is mounted. The tension of this spring tends to twist the stud around, and if it is not firmly held in the supporting frame such movement may result. Strange as it may appear, there are many machines in which nothing but friction is depended upon to hold the stud from turning. In such designs, if for any cause the clamping nut becomes loose, the stud swings around, and then the brush, if on the lower side of the commutator, drops down, while if on top, it dances up and down, producing serious sparking, which, if not rectified at once, may result in a short circuited armature and a burnout. A machine of this kind can be rendered safe by inserting pins of hard fiber in the joints between the stud and the insulating bushing, and also between the bushing and the supporting frame, as is shown in the illustration by the small black circles.

Brush holders of the type shown in Fig. 1 are generally used with metallic brushes, but they are also used with carbon brushes, although not so much now as a few years ago. It is not a good design for carbon brushes, as these are liable to break off by being suddenly jarred, and in such an event the results would be sure to be severe, and possibly very serious.

Of the metal brushes, the woven wire or gauze, as they are variously called, are the best; they last longer, run with less sparking, and do not cut the commutator as much as the leaf brushes. The latter type of brush is stiffer than the gauze, and in most cases they are provided with an extra thick back, which keeps them from bending. Owing to this fact brush holders, designed originally to hold leaf brushes, are not provided with means for supporting the brush near the end. In consequence of this fact, if a gauze brush is placed in such a holder it is very apt to be drawn around by the friction of its end against the commutator surface into the curve shown in Fig. 2. If a brush is drawn into this position it will not run well. In the first place it will be out of the proper position for sparkless running—that is, if it was set in the true position when straight. In the second place, it will produce an unnecessary friction and may result in cutting the commutator badly. The easiest way to prevent this trouble is to cut a piece of spring metal, preferably brass, about one-thirty second of an inch thick, and place it in the brush holder so that it may reach nearly to the end of the brush, as is shown in Fig. 3 at b.

Gauze brushes should never be placed in holders intended to hold carbon brushes in a position perpendicular, or nearly so, to the commutator surface. Gauze brushes will not run well in such a position, but must be held in inclined holders, as in Fig. 3. Carbon brushes can be used in connection with brush holders that clamp them tightly, or in holders that allow them to slide through. In the latter type of holder the brush is pushed endwise through the holder against the commutator surface. Gauze brushes cannot be used in holders in which the brush is intended to slide endwise, but must be firmly clamped by the holder, and the tension against the commutator surface must be obtained by forcing the brush holder against it.

Formerly it was customary for dynamo tenders to remove the brushes every day and file them up on the end so as to make a good contact with the commutator. This practice is not good, and has been abandoned almost entirely. The only benefit derived from the filing up process was that the scraggly ends and corners were removed. Outside of this, however, the filing did more harm than good, because it is not possible under ordinary conditions to file the end of a brush so that it will properly fit the commutator. The best way to treat metallic brushes, whether leaf or gauze, is to turn them upside down every few days so that they may be worn into the shape of a chisel end—that is, tapered on both sides. In this way the most perfect fit obtainable in practice is secured, for the end of the brush, being worn away by rubbing against the commutator surface, must be a perfect fit. The brushes should not be turned too often, for every time this is done the contact will be imperfect

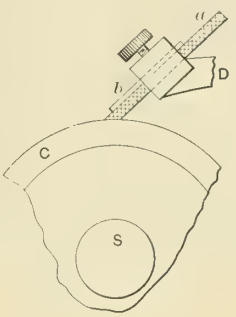


FIG. 3.

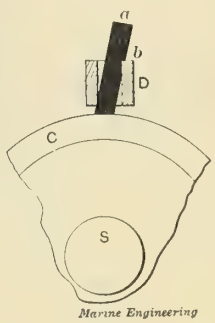


FIG. 4.

for some hours, until the metal has been worn away sufficiently to bring the whole width of the brush into contact. When the bevel that is running against the commutator is about twice as wide as the other one it is time to turn the brush over. This turning of the brushes over, so that they may trim themselves, in addition to saving time and trouble, possesses the advantage of making possible the use of thicker brushes, which will not only last longer, but, in addition, retain their shape better.

Carbon brush holders are made in many forms, some being very simple and others decidedly complicated. Many designers appear to believe that there is great difficulty in conveying the current from the holder to the brush unless the latter is tightly clamped, and on that account provide a frame in which the brush is secured, and this frame slides in the brush holder proper. This construction is entirely unnecessary, for even if the brush is very loose in the holder there will be no difficulty experienced on account of the current not passing to it freely. In some brush holders springs are provided to press against the brush, so that while it can slide through it is at all times hugged by the springs, and in that way a good contact is insured. The objection to this

arrangement is that on account of the pressure of the springs against the brush the latter is liable to stick occasionally unless the pressure with which it is forced against the commutator is much greater than is necessary, so far as sparkless running is concerned. Of all the many types of brush holders that have been devised, those in which the brush can slide through freely are the best—that is, of the designs in which the brush holder is stationary.

In some cases, where the brush is not pressed against the commutator by a properly shaped or supported lever, chattering becomes possible, and this may cause sparks to pass between the sides of the holder and the brush. If this action is allowed to continue, the brush may become worn away so as to hang on the edge of the holder in the manner illustrated at *b* in Fig. 4. When this occurs the result will be that after a while the pressure of the brush against the commutator will be reduced on account of the impossibility of the brush advancing, and when this state is reached there will be increased sparking. To obviate such trouble the best course to pursue is to file off the corners at the upper end of the brush holder so that the brush cannot become caught, and then endeavor to ascertain the defect in the pressure lever that allows the brush to chatter, and remedy this also. In Fig. 4 the brush is made decidedly too small for the holder, but this is done so as to illustrate the action more clearly. In practice the clearance between the holder and the sides of the brush need not be more than one or two hundredths of an inch, as the brushes are made very nearly of uniform width.

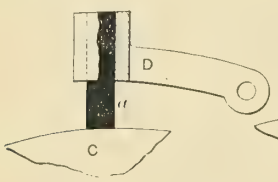


FIG. 5.

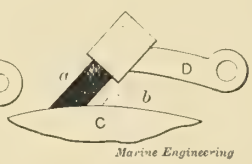


FIG. 6.

In all forms of carbon brush holders in which the brush slides there is no danger of the brushes being improperly spaced as the brush advances endwise, and therefore always strikes the commutator surface at the same point. In many of the forms of holders in which the carbon brush is clamped, there is every possible chance for the brushes to become improperly spaced. If a brush is held in a brush holder of the form shown in Fig. 5, there will be very little shifting of the position of the end of the brush upon the commutator surface as the brush wears away, for the simple reason that the brush is held in a line that is square with the radius drawn through the center of the stud around which the holder D swings. If, however, the brush is held in an inclined position, as in Fig. 6, then as the end of the brush wears away and the brush holder D swings around, the position of the brush with respect to the commutator will be changed, as is clearly shown by the broken lines *b*. From this it will be seen that with brush holders of the latter type it is necessary that the length of brush extending beyond the holder be the same in all, for if not, some of the brushes will be set in advance of the proper position, and some back of it, and under such conditions sparkless running cannot be obtained.

A great many people believe that lubricating the surface of the commutator is decidedly advantageous, and many commutator compounds are advertised that are claimed to work wonders in the way of suppressing sparking. It is a well demonstrated fact that when judiciously used, a small amount of lubricant reduces the friction, and thereby tends to keep down the temperature of the brushes, and thus to some extent reduce the sparking. On the other hand, unless the lubricant is used very sparingly, it is liable to do more harm than good, for when combined with the carbon dust from the brushes or the metallic particles detached from the commutator it becomes a fairly good conductor and may assist in establishing short segments between the segments. Owing to this fact it is safe to say that if a commutator runs well the best course to pursue is not to use lubrication of any kind upon it.

French Torpedo Boats.

After successful trials the torpedo boats *Bourrasque* and *Rafale*, built by Augustin Normand and Company, of Havre, France, were delivered to the French Government. They are of the *Cyclone* unprotected class, with the following dimensions: Length on load line, 147 feet 6 inches; extreme breadth, 16 feet 7 inches. The weights carried on trial exclusive of chains, anchors, masts, boats, etc., and comprising only torpedoes, torpedo tubes, compressing pump, artillery, ammunition, provisions, water for crew and boiler, coal necessary for steaming 1,020 nautical miles at 14 knots, crew and effects, amounted in all to 34.5 English tons in the *Bourrasque* and 39.2 tons in the *Rafale*, the displacements being 153.3 and 158 tons, respectively.

The full speed trials, which took place after the ordinary preliminary runs on the measured mile, were of four hours' duration. The first hour was to be run at 25 knots minimum, the next hour maximum speed, and the remainder of the time at 25 knots speed. The one hour maximum speed was 31.53 knots for the *Bourrasque* and 31.41 knots for the *Rafale*. The mean of the three other hours was 25.79 and 26.20 knots, respectively. The boilers are of the Normand type.

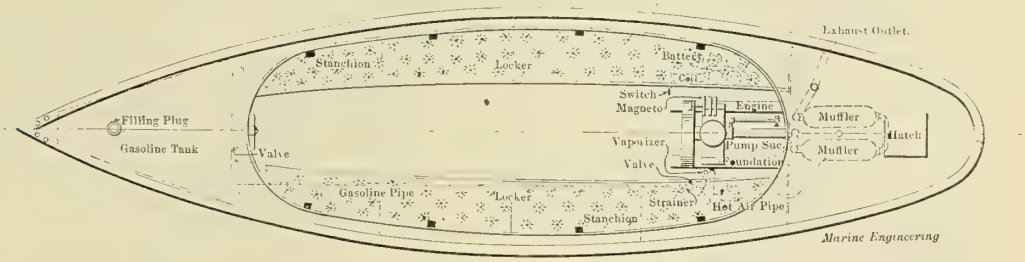
Order for Tugboat.—Theodore Smith's Sons and Company, Jersey City, N. J., have received contract for an 80-foot tugboat from the United Fruit Company, Boston, Mass. When completed the boat is to be used in Cuban waters. They also have orders for two dredges.

Oil Fuel at Sea.—An important incident in the progress of crude petroleum as fuel was the arrival recently in the Thames of the steamship *Murex*, from Singapore via Cape Horn. This is the longest voyage yet undertaken with oil as fuel. It is stated that the estimated saving in good Welsh coal was about seven tons per day, which estimate is based on previous trips of this steamer over the same route. It is also stated that only three firemen were employed, whereas the former force for handling coal was twenty-four.

ENGINEERING SPECIALTIES.

Gasolene Pleasure Launch Dorothy.

The accompanying illustration shows a pleasure launch, the motive power of which is furnished by a gasolene engine. The launch is 22 feet 3 inches over all, 19 feet 2 inches on the water line, 5 feet 6 inches beam and 2 feet 9 inches deep. The keel is of white oak, sided 3 inches, molded 5 inches; the stem and stern post are of white oak kneed into the keel; the frames are of white oak, sided 1 1-4 inches, molded 1 1-2 inches at keel, and 1 inch at head; the clamps are of white oak 3-4 inches thick and 3 inches wide; the sheer strake, plank sheer and coaming are of quartered oak, polished; the planking is of white cedar 7-8 inch thick; the deck is of white pine, polished. The stanchions and carlines for standing top are of white oak, the top is white pine, covered with No. 12 canvas, and painted; this top has a hatch fitted in it for convenience in getting in and out of the boat. The inside of launch is finished in cherry, and fitted with extension lockers and cushions, so that six persons can sleep comfortably, while on an outing. The top is fitted with storm curtains, a lookout being provided in the bow curtain, so that it will not interfere with the steering of the boat.



22 FOOT GASOLENE PLEASURE LAUNCH.

The motive power is a four horse power Lozier gasolene engine; the propeller is of bronze, twenty inches diameter, with a pitch of thirty-six inches; it is of the reversing type, with two blades, and turns 340 revolutions per minute. The shafting, shoe, stuffing box and rudder are of bronze, in order that the launch may be used in salt water.

The tank is of copper, 52 gallons capacity, and fitted in the bow space, but arranged so that it can be taken out at any time. This is accomplished by keeping it up, so that it does not come below the top of the lockers, except in the middle of boat where it will clear them in sliding in place. It rests on a floor built in the bow of the boat; this floor is made to conform to the bottom of tank, so as to stiffen the bottom. At the sides, top and each end, are fitted braces well secured to the boat, so that when the tank is in place it is thoroughly secured, which is very desirable in a small boat on a rough sea. Copper bulkheads, or stiffeners, are fitted to the inside of tank; these also act as swash boards.

The tank being fitted above the lockers on the sides, and only a little below them in the middle, insures a gravity flow of oil to the engine until the tank is dry. The tank was first riveted together and the inlet and outlet nozzles riveted on, and then everything was soldered up to make a tight job.

The piping from the tank to the engine is of brass, and is run through one of the lockers, with a valve on the tank and one at the vaporizing valve near the engine. As a needle valve, such as is fitted to a vaporizer, cannot be depended upon to remain tight, an additional valve was placed in the piping. In the piping just forward of the after stop valve is fitted a strainer which can be taken out at any time. This was put in to thoroughly strain the oil the second time before it goes to the engine.

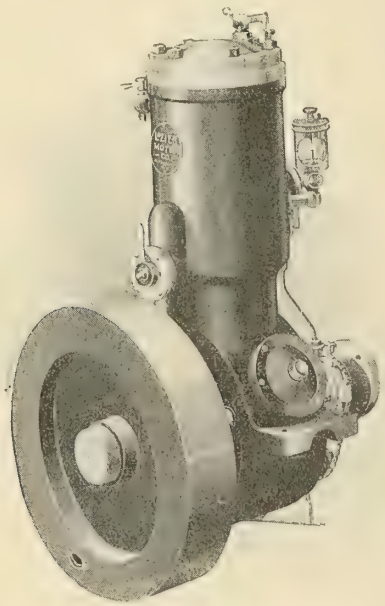
Too much care cannot be taken to clean the oil, as this is important in a good working gasolene engine, where the supply is regulated with a needle valve, as the opening in such a valve is very small, and any dirt collecting in it will soon reduce the opening so that the engine will slow down and finally stop.

The piping from the tank to engine is of brass, and the threads on pipe and fittings were tinned first, then screwed up and sweated together, thus making a thoroughly tight job throughout.

The illustration shows the Lozier engine, as fitted in the launch; it is a two cycle, four horse power motor, making 340 revolutions per minute.

The vaporizer is secured to the crank case. The oil and air passing through this valve is thoroughly mixed on entering the crank chamber. As the piston ascends, the mixture is drawn through the vaporizer into the crank chamber, and when the piston descends, the valve in the vaporizer closes and the charge is compressed in the crank chamber, and the piston, on reaching the lower end of stroke, opens a port connecting the cylinder with crank case, causing the charge to rush into the cylinder through the port striking a baffle plate, secured to the top of the piston, so that it is directed up to the top of cylinder, thus forcing the burned gases out of the top of cylinder down through the exhaust port into the exhaust pipe. As the piston returns on the up stroke, these ports are closed, and the charge is again compressed in the top of the cylinder, and then ignited at a point as already determined upon by the adjustment of the ignitor mechanism. If the spark is caused by batteries, the contact should be as short as possible, as the life of the batteries greatly depends on the length of contact; if a magneto is used, a much longer contact can be made. A throttle valve is fitted in the port, with a convenient handle, so that the charge entering the cylinder can be throttled, and the engine can be run at any desired speed below the maximum, by simply

turning this handle until the desired speed is obtained, no other change being necessary. By this method a rich mixture is always drawn into the cylinder, which insures a perfect ignition at all speeds, and only using the amount of oil necessary for the throttled charge. With this throttle the engine can be slowed down in the same manner as a steam engine. The ignitor is worked by an eccentric from the main shaft, and, if necessary, it can be adjusted while the engine is running. The switch on top of the cylinder head is the main switch, and can be thrown out or in by lifting it up or dropping it down. The water circulation is very complete, as it passes around the cylinder through the cylinder head, and passes off around the exhaust pipe, thus keeping all parts of the engine cool. The water is circulated by a rotary pump, driven by chain and sprocket wheel from the main shaft. The main bearings are of bronze, and in addition to the crank case oiling, they are fitted with compression



LOZIER GASOLENE ENGINE.

grease cups, conveniently located. Oil is put into the crank case for oiling the internal parts; the lower end of crank pin bearing has a wiper secured to it, so that oil is well distributed by it at each revolution of the engine.

The thrust bearing is of the ball bearing type, and fitted to the shaft so that it is adjustable for wear.

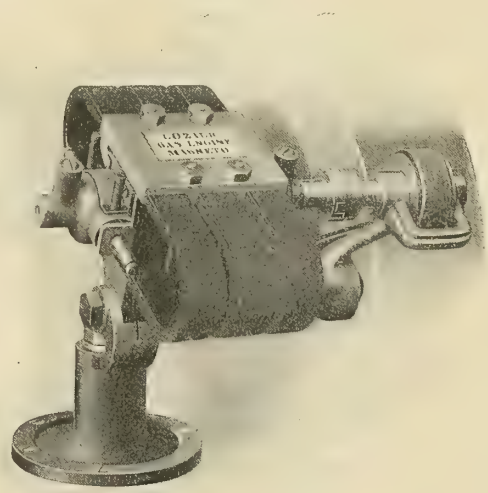
The magneto is secured to the engine proper, and fitted with a flexible shaft and ball bearings, so that the friction wheel is always held firmly against the fly wheel, thus doing away with the rigidity which would tend to overheat the bearings of the magneto.

There are six batteries, so that the engine can be run on the batteries or on the magneto at will, by simply throwing in the switch for either. The batteries are always used in starting the engine; after it is started, the magneto is substituted.

There is a double muffler placed in the exhaust pipe under the after deck, which reduces the sound of exhaust to a minimum; this sound cannot be heard when sitting in the boat on the opposite side from the exhaust outlet.

A hot air box is not used in connection with this engine, the hot air pipe taking air from between the two mufflers, these being covered over on top and down the sides by asbestos paper, thus forming a hot air pocket, and by this means all the hot air is drawn out of the space under the after deck.

The engine foundation is of white oak, a keelson on each side of the keel, notched over the frames and let down and fitted to the planking. There are three athwartship pieces notched into these and secured by through bolts to the keel. The fore and aft keelsons are held together by through bolts, so that the engine foundation is solid with the boat, as if of one piece. It is very important to have a good, solid foundation fitted in a boat, when a gasolene engine is to be installed, as the vibrations will soon work it loose if it is not properly put in.



MAGNETO SPARKING DEVICE.

Pipe Expanding and Threading Machine.

The Lovekin expanding and flanging machine, as shown in the accompanying figure, is a machine designed to meet the demands of shipbuilders and engineers generally where a large amount of wrought iron, steel and copper piping is used, and where such piping is required to be expanded tightly in the flange as well as beaded over the same. It is designed with a view of dispensing with the common practice of screwing flanges on pipes, especially so when such pipes are subjected to the action of salt water or to any vibration. When it is considered that the piping throughout ballast tanks is usually made of wrought iron for salt water, and after being galvanized, has a thread cut on same to receive the flange, it is evident that the life of the pipe is of short duration, as it will corrode at the bottom of the thread first and is a continuous source of trouble. On the other hand, by the use of this method the thickness of the pipe remains uniform throughout, and can therefore be a much lighter gauge for the same lasting qualities. Furthermore, in the case of copper pipes, instead of destroy-

ing the copper by hammering the same into a flange, this machine does a perfectly uniform piece of work throughout, and no comparison can be made as to the character of its tightness.

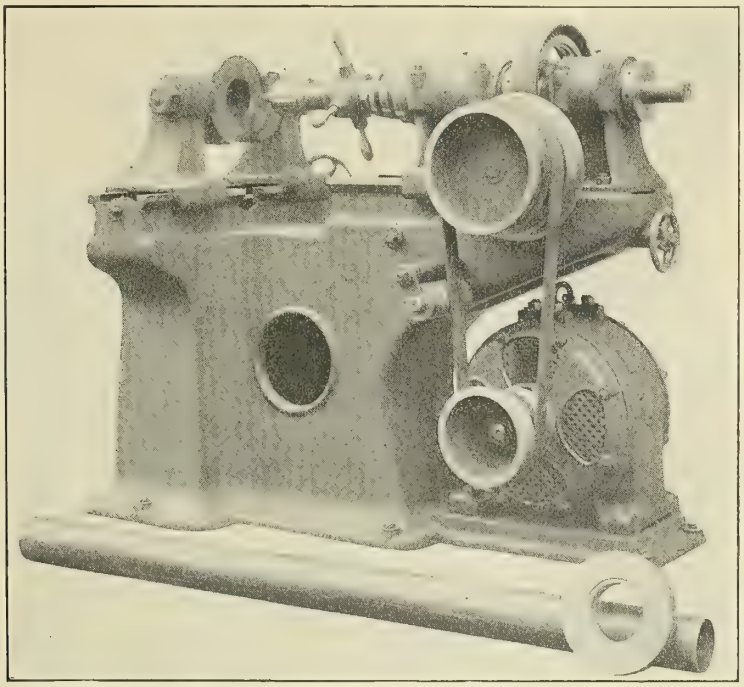
Samples of copper pipe which have been expanded with this machine, and without any brazing whatever, have been tested to rupture with 2,000 pounds pressure per square inch on a four-inch pipe, during which there was not the sign of a leak. Comparative tests between pipes brazed and hammered in, and those done by this machine without any brazing, have been made as to their pulling qualities, and in every case the pipe has broken at the point of brazing at the back of the flange, thus proving the superiority of the one not brazed.

The machine is supplied with a three-horse power electric motor, or can be run by counter shaft overhead, and the one shown in the engraving has a complete set of fourteen tools, clamps and jaws from 1 1-2 inches to 8 inches in diameter.

The tools usually furnished with this machine are for expanding the ends of the pipes so as to make contact between the ends or expanded inner surfaces. Tools, however, may be furnished for making any type of joint, particularly the flanging of seamless drawn tubing for steam pipes of high pressure as adopted by the United States Navy Department, the British Admiralty and other governments for their most recent cruisers, battleships, etc. For this class of work a cutter is provided for simultaneously expanding, flanging and facing off the end of the tube so as to make a perfect joint without removing pipe from the machine.

The time necessary to do the work on this machine is as follows: For iron or steel 4-inch pipe 3-16-inch thick, 10 minutes; 8-inch pipe 5-16-inch thick, 20 minutes. Copper pipe requires a trifle less time. Where extra heavy piping is required special tools are provided to do any thickness of tubing without the possibility of breakage.

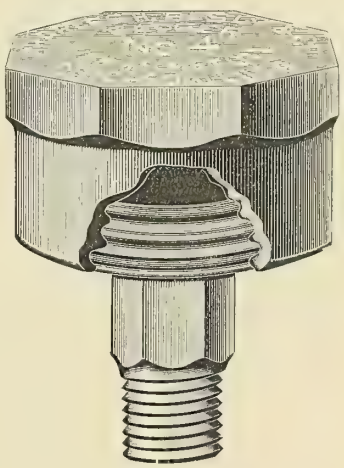
Further information may be obtained from the Keystone Machine Tool Works, Philadelphia, Pa.



PIPE EXPANDING AND THREADING MACHINE.

New Oil Cup.

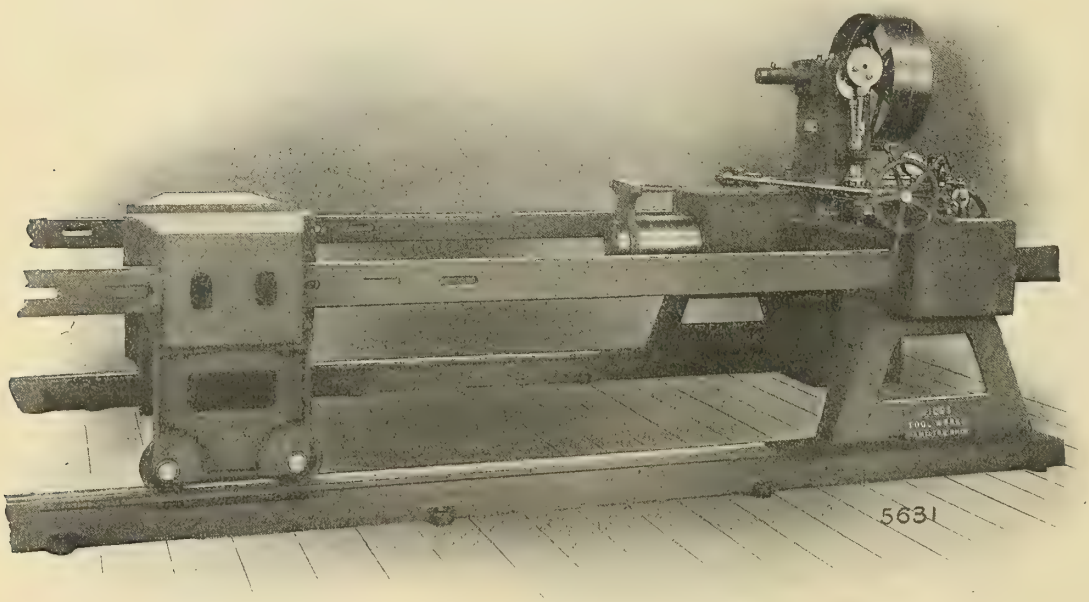
Messrs. Charles H. Besly and Company, 10 North Canal street, Chicago, Ill., have placed on the market a new oil cup which is especially adapted to be used with Helmet oil. It is called the Badger oil cup and is illustrated in the accompanying cut. It has an octagonal cap and can be operated by hand or wrench. The base of the cup has a round thread with hexagon



A NEW OIL CUP.

steel stem threaded, screwed into base and extended. As shown in the sectional view, the thread in both the cap and on the base is round, thus decreasing the possibility of the threads stripping, crossing or clogging. This cup can be used on all classes of machinery and among the advantages claimed for it are that it will neither leak nor break. It is made in six sizes ranging from 1 1-4 to 3 5-8 inches outside diameter, with pipe thread of from 1-4 to 1-2 inch.

Upon application to the manufacturer, a sample of this cup will be mailed to intending purchasers, together with prices and full descriptive matter.



HORIZONTAL HYDRAULIC FORCING PRESS.

Horizontal Hydraulic Forcing Press.

A design of a horizontal hydraulic forcing press has recently been placed on the market by the Niles Tool Works Company, Hamilton, Ohio, and is made in sizes of both 300 and 400 tons capacity. The 400-ton machine is here illustrated, although both are of the same design. The machine stands parallel with the line shaft, and the tie parts are placed at the sides, leaving the top free for crane chains, the machine being mounted on two parallel base plates, on which the sliding head rolls. The cylinder is bored true, and is lined with copper, which is expanded into place and burnished. Cup leather packing is used on the piston. The ram is 14 inches diameter with a stroke of 48 inches, and is counterweighted so that it returns automatically when the release valve is opened. The safety valve placed in a box cast on the cylinder may be set to open at any desired pressure, and then the box can be locked up. The pressure gauge is graduated in both total tons pressure on the ram and pounds per square inch of its area. The pump is double acting and is controlled or stopped by trip valves without necessitating shifting the belt. The discharge from the cylinder is led into a tank bolted underneath, from which the pumps take their supply.

This machine can be used for building up crank shafts of large dimensions. The distance between the tie rods is 8 feet, that between the ram to the sliding head 30 feet, and there is an opening in the head for 30-inch shafts.

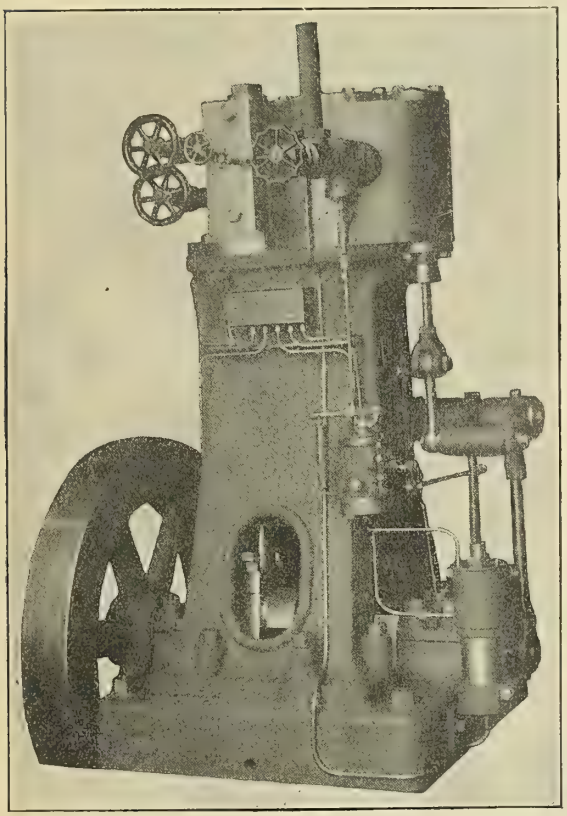
Carbonic Anhydride Refrigeration.

The adoption of refrigerating machinery on board yachts is becoming quite general, now that a machine is on the market which embodies the three features of safety, compactness, and efficiency. The objection raised to the ammonia machine is the annoyance in case of leakage and the danger of a possible explosion. The dense air system is rather heavy and cumbersome. Until recently the other safe system, the carbonic anhydride compression, has only been obtainable in Europe, but now an American machine has been placed on the market which will doubtless have a large sale on board ship.

The accompanying cut shows the vertical direct-connected steam-driven compressor for carbonic anhydride refrigeration built by The Cochran Company of Lorain, Ohio. The steam and compressing cylinders with their cross heads are carried on a single frame, supported in turn upon a rigid bed-plate in which are formed bearings for the crank shaft. The shaft is of unusually large diameter, and its two cranks are so placed as to give the best possible distribution of power and load. Piston valves are used, the valve itself being a simple cast-iron disk, readily replaced at small expense when worn, so that the steam cylinder may be operated without internal lubrication, a very desirable feature for marine use. The various

journals are lubricated from a large oil-box placed at a convenient height. The compressing cylinder is made from a solid steel forging, and is thus of great strength and absolutely gas-tight. The packing of the piston-rod is done by cup-leathers as usual, and a direct-connected oil-pump is provided to automatically maintain the proper pressure between the leathers and thus prevent the escape of gas. All valves of the compressing cylinder are of nickel-steel, and each one is instantly accessible by removing a threaded cap, and all are interchangeable.

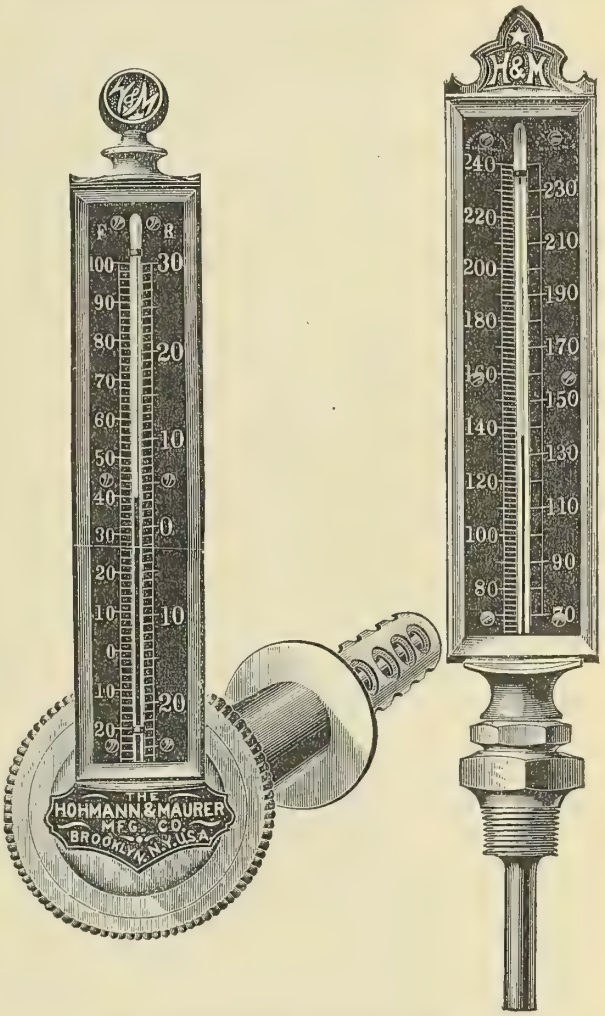
Gas condensers for these machines are fitted with copper pipe, thus giving a long life to the apparatus using seawater for condensing purposes. All pipe fittings are of steel forgings or castings, and every fitting and piece of pipe used is tested under 1,500 pounds air pressure while submerged in water, and thus proved absolutely tight.



CARBON ANHYDRIDE REFRIGERATING MACHINE.

Of these vertical machines three sizes are made, having capacities equal to the melting of two, four and six tons of ice per day of twenty-four hours. For placing the apparatus in a confined space, such as the shaft alley, the compressor, condenser and brine-cooler of these small sizes are made in separate units, so as to be placed separately in whatever space is obtainable. Larger machinery is of the horizontal type, with condenser constructed in the base of the machine. Electrically-driven machinery is also made for use when this method of driving is preferred.

The Cochran Company has supplied its machinery to the yachts *Conqueror* and *Corsair*, and steamers of the American Line, and is prepared to furnish from stock duplicates of successful machinery already constructed, of capacities from one-half to fifty tons of refrigeration per day, in single units. The presence of these machines cannot be detected by noise or by odor. Their weights are not excessive and the steam consumption is small. Carbonic anhydride to replace the slight leakage, is cheaply purchasable in any large city, and a supply for many months occupies but li tle room. By the use of this machine the yacht owner may exchange a ton of coal for from five to fifteen tons of ice or its equivalent in refrigeration.



THERMOMETERS FOR ENGINE ROOM USE.

Thermometers on Board Steamship.

Every seafaring man is familiar with the thermometer, so called, since it plays so important a part in his daily observations. However, the thermometers here described should be properly called temperature indicators, and by their use the economic operation of a ship may be increased. Beginning with the boiler equipment, the importance of attaining correct records of the temperature of the feed water heater, hot well, inlet and discharge from the condensers, is appreciated by every engineer. Careful watch must be kept on the pressure and vacuum gauges, which for certain

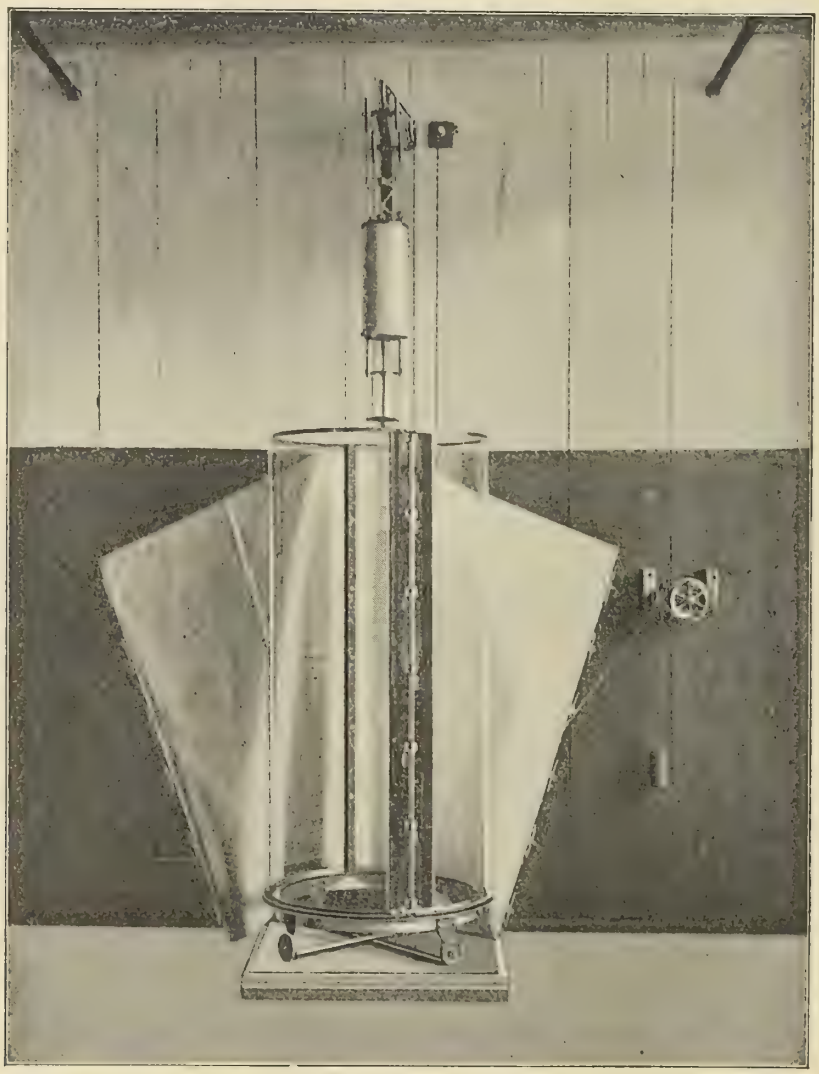
purposes must be supplemented by more reliable indicators, as for instance, on condensers where mercury column vacuum gauges are frequently used. By placing a high-temperature thermometer in the flue or uptakes from the boilers, the engineer can decide what position of the damper is the most efficient.

As most steamships of our day carry refrigerating and ice-making machinery, the temperature indicators are of no small importance in successfully operating this machinery, and here should be used thermometers for taking the temperature of the circulating brine in the freezing tanks, at the pumps, or in the distributing pipes. A special thermometer is made for indicating from the outside the temperature of the cooling chambers or cold storage rooms; and other forms of installment are used to determine the degree of cold in the hold of vessels engaged in the meat trade. An ingenious device lately perfected and used extensively in the United States Navy is a maximum and minimum thermometer for determining the very important matter of temperature in the magazines and coal bunkers.

For the above mentioned purposes, thermometers used must be accurate, practically constructed, and so attached to the various pieces of apparatus as to permit of making repairs at sea. All these points are covered by the goods manufactured by the Hohmann and Maurer Manufacturing Company, Rochester, N. Y., to whom further inquiries may be addressed.

Electric Blue Printing Machine.

The many disadvantages connected with blue-printing by sunlight are overcome in the cylindrical electrical copier made by the Pittsburg Blue Print Company, Pittsburg, Pa. This machine has been installed in large numbers throughout this country and abroad, and has given satisfaction wherever used.

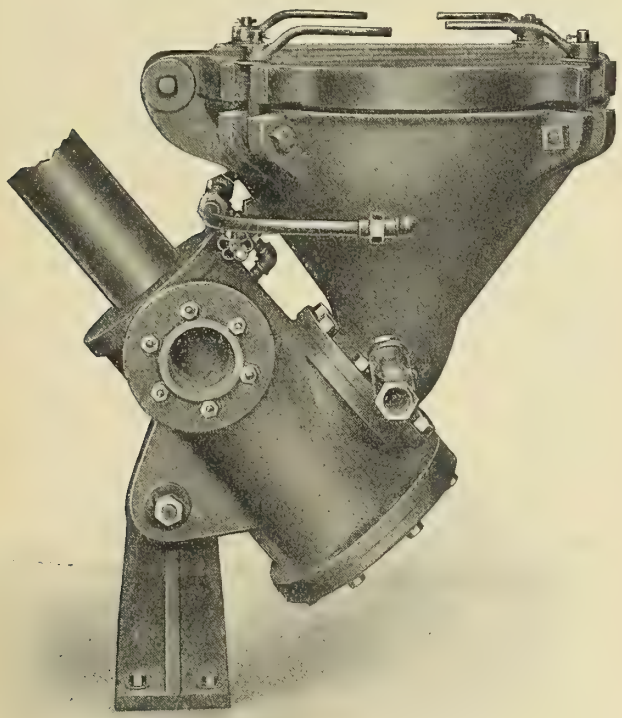


MACHINE FOR MAKING BLUE PRINTS BY ELECTRIC LIGHT.

The apparatus is made in convenient form so as to take up little room and to be of the best service in adverse conditions. The accompanying cut shows the general features of this machine. The glass cylinder is made of the best glass and the frame and angles are of wrought iron pipe. The tracing which is to be printed is wrapped around the cylinder, the

blue print paper placed over it, and then the adjustable covering which holds the two in close contact is fastened on. The electric lamp is of special design and so constructed as to give a uniform intensity of light. The lamp is lowered with uniform speed down through the cylinder and raised again, its operation being practically automatic, so that whatever attention is required can be entrusted to a boy.

The advantages of this machine are, that it does not depend upon the weather, and is thus absolutely independent of sunlight; the prints are of uniform color, and the saving of labor is very large.



A NEW ASH EJECTOR.

Hydraulic Ash Ejector.

The Davidson Ash Ejector has in the short time it has been on the market become greatly appreciated on account of its reliability in performing quickly and easily the hitherto very unpleasant job of disposing of a steamer's ashes.

It is built on scientific principles which overcome the objectionable features to be found in other machines designed for this purpose. The body of the ejector is set at the angle of inclination of overboard pipe, thus dispensing with one elbow or bend, and as the wear in this pipe is principally at the bends, this is important.

The hydraulic stream which operates the ejector enters on delivery end of ejector cylinder, striking a contracted nozzle which projects it through delivery pipe, drawing ashes, etc., from bottom portion of ejector cylinder to this point by vacuum created by the stream going overboard, with which the ashes mingle, and as they must pass through an orifice smaller in diameter than the overboard pipe before coming in contact with the hydraulic stream, it will be seen that the clogging of the pipe is impossible.

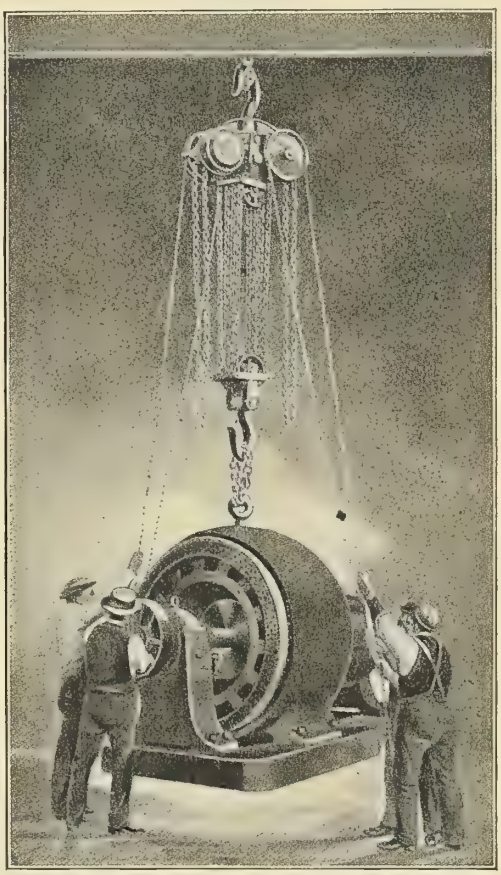
In case a clinker too large to pass through this opening should be thrown into the ejector, the stream will continue to pass overboard and not rise through hopper and flood the fire room, as in other ejectors, while the obstruction can be easily reached with a bar and broken up or removed.

The hopper is provided with two small jets which wet the ashes and wash them into the body of ejector.

These ejectors will operate with less water and at a lower pressure than any other.

At a trial of one of these ejectors, size 4 inches, with a 4½-inch discharge pipe, 4,000 pounds of ashes were discharged 14 feet above hopper and 8 feet from end of discharge pipe, in nine minutes and a half.

Further information, with prices and plans, will be cheerfully furnished by the manufacturer, M. T. Davidson, 141 Broadway, New York City.



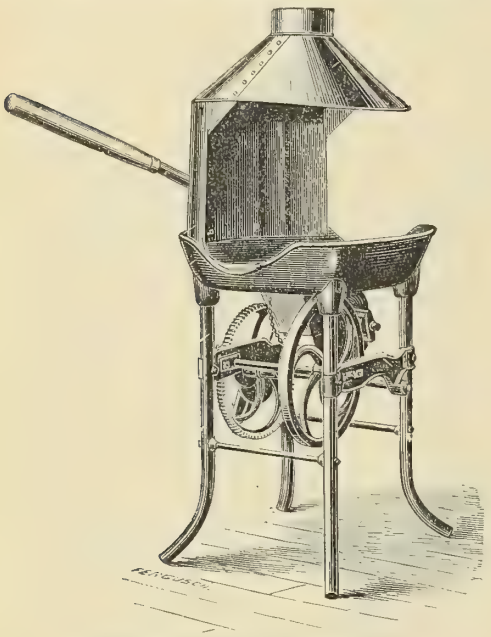
TRIPLEX CHAIN BLOCK FOR PORTABLE HOISTING.'

Quick Lifting for Heavy Work.

The problem of overcoming gravity in the handling of material has always been a knotty one, and heretofore the mechanic requiring a portable hoisting machine has been forced to content himself with appliances which waste in the friction of the moving parts

a considerable fraction of the power applied to the machine. In the Triplex Chain Block illustrated herewith, it is claimed that this loss is greatly reduced, owing to a transmission of the power through a balanced train of spur gears, with an independent automatic device for sustaining the load without wasting the operator's time and strength in hoisting against unnecessary friction. By this means an efficiency of nearly 80 per cent is claimed, marking a radical departure in this class of machines and making this the only block wherein the power to hold the load self-sustained at any point is not due to excessive friction which must be overcome in hoisting.

Twelve, sixteen and twenty ton sizes are made similar to the block shown in the illustration, with two independent hand chains arranged so that these loads may be lifted as fast as was formerly possible for a five-ton load with the screw or differential gear-



FORGE FOR OUT-DOOR SERVICE.

ing commonly used. The smaller sizes are made with a single hand chain in the usual manner, and their ease and speed in lifting, together with their rapid and easy lowering, make the Triplex Block a saver of half the time and two-thirds of the power necessary to accomplish the same work with other hand hoisting appliances. Wherever quick work is wanted and economy in time and labor is sought, this block is rapidly replacing the older types.

This block is made by the Yale and Towne Manufacturing Company, 9 Murray street, New York, who publish a complete catalogue giving full information in regard to all sizes and kinds of chain blocks.

Empire Forges.

Forges of various types to suit the many branches of iron working, are built by the Empire Forge Company, Troy, N. Y. They are made for light or heavy work, for use in machine or blacksmith shops or for out of door work in shipyards or in bridge work. They are heavy, strong and durable, have bronze bearings, and the blower is geared instead of belted, and therefore there is no back motion. The forge here illustrated is for ship or bridge work and is built with a hood. The legs are of wrought iron pipe, there is a swivel handle, and when desired an iron ring is placed around the tuyere. As the entire forge is of metal, it is specially adapted for out of door service.

Consolidation of German Shipyards. — Carl H. Ziez announces that the work of the firms of F. Schicau, Elbing and F. Schicau's shipyard in Danzig will henceforward be vested in the sole right of himself and wife and that the work of the former firms will be carried on in an unchanged manner.

Barges for Manila.—The steamship *Melbourne*, belonging to the Philippine Transportation and Construction Company, recently left New York for Manila with a general cargo and nineteen steam barges. These barges will be used as steam lighters in the harbor of Manila and elsewhere about the islands for transferring freight from ships to land.

New Yachts.—There are ten new yachts, eight of them to be propelled by steam and two by sail, now building at the works of the Gas Engine and Power Company and Chas. L. Seabury Company, Morris Heights. These yachts are expected to be in commission in this city and will make fine additions to the Atlantic fleets.

Liquid Fuel in the Navy.—The Secretary of the Navy has transmitted to Congress to be included in the naval appropriation bill, an estimate amounting to $20,000, for the purpose of investigating the best means of burning liquid fuel for naval purposes. Accompanying the estimate is an urgent request from Rear-Admiral Melville for granting the appropriation.

Lehigh University Scholarships.—The following scholarships at Lehigh University, South Bethlehem, Pa., will be opened to competition at the annual examinations of June, 1902, for the collegiate year of 1902-1903: Two in the classical course, one in the Latin-science course and five in the following courses at $150 each: Civil engineering, mechanical engineering, electrical engineering, mining engineering, metallurgy and chemistry. The scholarships will be renewed from year to year, provided the holders thereof are in full standing in all their studies.

Lloyds Statistical Tables for 1901.—The total addition of steam tonnage added to the register of the United Kingdom during the year 1901 has been 1,173,390 gross tons, and of sail vessels 45,203 gross tons. The gross deduction of steam tonnage amounts to 488,449 tons, and of sailing tonnage 159,119 tons. The tonnage transferred to foreigners during the year amounted to 346,747 tons, which is the lowest total record for this item since 1896. Germany and Italy have been the largest purchasers during the last year, acquiring, respectively, 57,636 and 52,040. The vessels on the register of the United Kingdom on December 31, 1901, were, approximately, 9,488 steam vessels of 12,501,885 gross tons, and 10,571 sailing vessels of 2,133,312 gross tons, making a total of 20,059 vessels of 14,635,197 gross tons.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory With Practice.

BY C. A. MCALLISTER, FIRST ASSISTANT ENGINEER, R.C.S.

CHAPTER VIII.

When the Professor awoke on the following morning he thought he must be in Fairyland. It was quite early, and the usual morning breeze of the tropics was blowing in through the open windows. Looking out he could see the tall palms and cocoanut trees in the hotel grounds nodding in the breezes, and the air seemed to be permeated with the fragrance of tropical flowers. The birds were singing merrily, and, in fact, all nature seemed to be in a laughing humor. With such pleasant surroundings the Professor was loath to arise, so he remained in bed until about 8 o'clock, when a knock came at his door and he was informed that breakfast would soon be over. After partaking of a light breakfast, consisting of fresh fruit and eggs, he walked towards the wharf, feeling like a different man entirely, and contrasting his present surroundings and feelings with those of a few days before, when the ship was rolling and pitching in a gale of wind. Being somewhat of a philosopher, he soliloquized that, after all, pleasures are only matters of contrast. Had he been sleeping in a wide bed in a cool room for the whole week before he would not have had the feeling of exhilaration which he was then enjoying. He also concluded that the ratio of such mornings to the mornings of discomfort on shipboard was entirely too small to cause him to spend the remainder of his life going to sea.

Arriving at the wharf, he found the usual motley crowd which is always in evidence along the water front of a tropical seaport. Scantily dressed negroes of both sexes were lolling around; market men were vending their wares and a general air of confusion seemed to prevail. As soon as he stopped walking and looked out in the harbor he was surrounded by a dozen importuning boatmen, who all wanted to row him off to the ship. After considerable palavering he managed to make a bargain with one, and was soon comfortably seated in the stern of a small boat and was put on board the steamer.

After exchanging greetings with some of his fellow-passengers and with the ship's officers he decided that as he was feeling so well he would spend a part of the day in the engine and fire rooms. As he emerged from his state-room, clad in his overalls, he was accosted by the chief engineer, who asked if he was going to try it again below, at the same time cautioning him regarding the heat. He went on to tell the Professor that he had made arrangements with a shop on shore to have about fifteen new tubes put in the boiler which had been blown down, and that they would probably be in port until the following morning. This was cheering news, as the college man had some time before concluded that he wouldn't care if they stayed in that port for a month. As he went into the engine-room he found the first assistant and a gang of men hustling around, making adjustments and overhauling things generally. Much to his surprise he found that the engine-room was almost as warm as when the vessel was under way. It had never occurred to him that when the cylinders of a large engine become thoroughly heated it would take them such a long time to cool off.

Walking out to the fire-room, he found there a scene of confusion. The workmen from shore were busy removing the old tubes, and the din of hammering made it almost impossible to hear anything else. The second assistant was "bossing the job," and as the shore men were working by the hour the gestures he was making indicated that he was using some vigorous language in his efforts to get as much work out of them as possible. He took time, however, to nod to the Professor and beckon to him to come over to where he was standing. During a lull in the noise he informed him that while the old tubes were being cut out and replaced he was having the boiler given a thorough cleaning. Looking through one of the furnace doors he espied a man in the back connections vigorously brushing away at the surfaces and surrounded by a heavy pall of soot. This was a part of the duties of a fireman that the Professor had never witnessed before. As he was standing there a man crawled out of one of the wing furnaces to get a breath of fresh air. By a series of acrobatic motions he finally got out and stood up alongside of the Professor. The man's appearance almost horrified the sympathetic college man. He felt convinced that he was a white man, as there was none other in the crew, but from his present appearance he certainly looked like the blackest of negroes, and the Professor felt sure that his own mother would not have recognized him. His hair, which was naturally of a reddish tinge, was now as black as ink. His ears were almost filled up with soot. His skin was covered thick with a pasty-like substance composed of soot and perspiration, and his overalls, originally blue, were now as black as his shoes. In fact, the whites of his eyes and his teeth were the only visible parts which were not of inky blackness. In spite of his evident discomfiture, he smiled and nodded to the astonished college man as if he had casually met him on deck.

"Goodness gracious, my poor man, how in the world do you stand such work?"

"Oh!" said the fireman, "it's all in getting used to it, but, to tell you the truth, it isn't much fun, sir. I don't know but that I would rather clean the back connections than work inside," he continued. "Just look at Callahan in there," said he, pointing to one of the manhole openings.

The Professor looked through the opening, and by the flickering glare of a smoky hand lamp hung on one of the boiler braces he discerned the form of a man who was working away at cleaning the crown sheet of one of the furnaces with a wire brush. The man was simply wedged in between the furnace and the shell of the boiler, and just had sufficient room to work his arm. The Professor ventured a little closer and stuck his head inside the manhole. The sickly, warm vapor-like atmosphere inside the boiler soon caused him to withdraw his head and gasp for a breath of the pure air in the fireroom. His first impulse was to rush on deck and protest to his brother that it was nothing less than downright cruelty to compel men to work in such a place. While considering

this move his attention was attracted by a pair of shoes being thrust out of the manhole, which were soon followed by a man's legs, which, after being waved around in the fireroom, gradually elongated until after a final effort the whole of the man's body emerged from the narrow opening. The man proved to be Callahan, who, after drawing in a deep breath of cool air, smiled and said, "Good morning, sir; I thought I would come out and get a spell, as that is pretty hard work in there."

"Hard work!" said the Professor; "I don't see how you live, let alone do any work, in such an infernal place as that."

"Oh!" replied Callahan, "that isn't so bad; if we can get a whiff of fresh air occasionally and a few minutes' rest, I don't mind it so much."

The second assistant, overhearing the Professor's remarks, said to him:

"That's one part of the business that you don't learn in books, but it is something we practical men all have to go through with. I've done my share of it, and, in fact, I'll have to go all through this boiler today to see that these fellows have cleaned it properly."

The Professor said he was glad that he did not have to do it, "for," said he, "one day of that kind of work for me and there would be a vacancy in a certain college faculty that I know of."

"It isn't so bad as all that," replied the officer, "but it is something that has to be done, and we generally try to make the best of it."

Callahan had now finished his spell and crawled back through the manhole into the boiler, from which the faint sound of a man whistling could be heard as he resumed his work. The Professor again looked in and this time saw the fireman rubbing the crown sheet with a handful of old bagging. This, the assistant explained, was soaked in kerosene oil, and was for the purpose of removing such of the greasy deposits which had not been taken off by the wire brush.

"Isn't it dangerous to use kerosene oil around that old hand lamp?" inquired the Professor.

"Yes, I suppose so, but then the men have to be careful," said the engineer.

"What a horrible thing it would be if that man's oily clothing should catch fire in that cramped space," said the college man. "Why he would be literally roasted alive before he could get out."

"That is one of the pleasant things that goes with the job," said the assistant; "but how are you going to prevent such dangers?"

To this the Professor replied that he thought something ought to be done to make such work less dangerous and uncomfortable to the poor men who had it to do, and that he would try to think of some scheme to help them. Upon inquiry he learned from the engineer that there were six men cleaning the inside of the boiler, and that it would probably take them all day to complete the job. The interior had been found to be fairly clean, except for a thin coating of grease and scale on the heating surfaces and on the shell at the water line. When it got very dirty, he was informed that it was customary to boil it out with soda and concentrated lye and then give it a thorough blowing out through the surface blow.

The Professor said, "Of course you only clean by hand such portions of the heating surfaces as can be gotten at, but how do you clean the tubes which are inside of the outside rows?"

"We don't clean them at all," replied the assistant, "except what cleaning they get by the boiling-out process, and that, I find, does not remove the grease and scale from those tubes."

"As those tubes constitute more than three-fourths of the heating surface," said the Professor, "it seems to me that some attempt should be made to get at them for cleaning purposes."

"Well the only way that I know of is to cut them out and put in new tubes," replied the engineer.

As the Professor felt that he was in the way, and taking up too much of the engineer's time, he determined to go up on deck and to come down in the fireroom again after luncheon. After this function was over he called the subject of boiler cleaning to his brother's attention, and remarked that something ought to be done to make the work a little less irksome. To this the chief replied that he was ready for suggestions.

"Well," continued the theoretical brother, "I have thought the matter over, and my ideas may seen impractical to you, but, for one thing, I would not let a man go inside a boiler with one of those miserable hand lamps. You have steam on the boilers, and a dynamo that is not in use. You certainly ought to have a half-dozen portable hand lamps and sufficient insulated wire to reach to any part of the boiler. With electric lights the men would not be in danger of having their clothes catch fire, and they would not have to breath the horrible smoke from burning lard oil in the lamps. The air in a boiler recently blown down is certainly foul enough without the addition of so much of this sickly smoke."

"Another thing is, that you have a whole lot of electric fans on board here which are not now in use. What is to prevent you from connecting three or four of them up so as to blow fresh air into the lower manholes so as to create a current of air through the inside of the boiler and thus get rid of a great deal of that foul vapor that collects there? Of course I know that you may think these ideas are a little 'old maidish,' but I feel convinced that a few little attentions like these to the comfort of the workingmen would be more than compensated for by the increased amount of work that would be accomplished."

"I think that it is also possible to devise a rotary wire brush that could be operated by a small electric motor, and manipulated by a man inside of the boiler. In that way the crown sheets could be cleaned in a third of the time now taken up on cleaning them by hand. I also understand that an electric brush has recently been patented for cleaning in between the tubes, which cannot be gotten at by hand. This motor rests on a moving carriage which is slid along on top of the tubes, and which operates a long steel wire brush which is so shaped as to fit in between the adjacent rows of tubes in such a manner as to clean the entire surface."

The chief, after giving the suggestions considerable thought, remarked that he thought some of his

brother's ideas were good ones, and that the next time they cleaned a boiler he would try the electric lights and the fans.

"It won't cost anything to speak of, and it might do some good."

The Professor sat around under the awnings watching the unloading of freight, until about four in the afternoon, when he decided to take another look into the fireroom. It was still quite warm down below, as there was very little breeze blowing, and consequently but little air was driven down the ventilators. Much to his surprise he found that all of the damaged tubes had been drawn out, and over half of the new ones had been put in their places. He took occasion to examine some of the old tubes which had been cut out, and found that most of them had leaked on account of pits, which had eaten clear through the metal.

He found upon inquiry that but little of the old zincs were found inside of the boiler when it was opened up, which satisfied him that the damage to the tubes was occasioned by neglect in looking after the zincs. Although no baskets were to be had for holding the new zincs, at that time, he was much pleased to learn that the second assistant had put in a liberal amount of new zinc plates, and that they had been connected to the braces in the manner that he had described. The second assistant inquired of him as to how much zinc he thought ought to be put in the boiler. To this the Professor replied that it was very hard to tell, as it depended largely upon experience. He suggested, however, that it would not be far out of the way if they used about a ratio of five pounds of zinc for each square foot of grate surface in the boiler.

The men had finished cleaning the interior of the boiler and had gone on deck to wash up. The manhole plates had been replaced and everything was in readiness to start fires as soon as the boiler-makers finished putting in the remainder of the new tubes. As it was impossible to do this before eight o'clock in the evening, the Professor decided that he would spend another evening on shore. As he walked through the engine room on his way up he could not help noticing how neat and clean everything looked when contrasted to the appearance of things on the previous day. The floor plates had been thoroughly cleaned, and all the brass work about the engine was shining. Seated on a box in a corner was Barney, with his face buried in his hands. Upon being asked if he was ill, the oiler replied, "No, sir, I'm not exactly sick, but I'm on the *sthool* of *repintance*. I wint ashore lasht night and drank a whole lot of that dago booze they have here, and my head has felt as if there was a wather hammer in it all day."

The Professor smiled and said that it must have been an alcohol hammer he had felt.

"You know, Barney," said he, "that the best way to stop a water hammer is to shut down on the throttle, so the best way for you to prevent these headaches is to throttle your thirst when you go ashore."

"Right you are, sir!" groaned poor old Barney.

After a few expressions of sympathy for the oiler, the kind-hearted Professor went to his stateroom and prepared to spend another evening on shore before the ship sailed.

TECHNICAL PUBLICATIONS.

LIGHT, HEAT AND POWER IN BUILDINGS. By Alton D. Adams, Member American Institute of Electrical Engineers. One 12mo. vol., cloth; 102 pp. Price, $1. New York: W. T. Comstock.

This book is intended for the architect and building engineer. It is intended to be practical rather than theoretical, and to present in compact and convenient form the main facts relating to the various sources available for light, heat and power in buildings. Questions of economy and efficiency occupy chief attention, and the purpose is to aid in the intelligent selection of the means best suited to the special ends in view. Special attention has been given to setting down, side by side, the costs of service from different sources, thus making comparisons simple and direct.

The general purposes of the book seem to have been carried out with good judgment and care. Questions of cost, of special adaptability, of relative desirability, etc., must often contain a considerable personal element, and while the author is free to give in his opinion the points for and against various systems, it is done in a manner with which none can find fault, though one might not always agree with his conclusions.

The book is well written, contains in convenient form a large amount of valuable information, and may be recommended to all who are interested in the problems with which it deals.

Novel Method of Raising a Wreck.—An unusual method was used in raising the wreck of the bark *Arthur*, which foundered in Boston Deeps, Lincolnshire, during the heavy gales of the present winter. The decks and the inner structure of the ship were removed, leaving only the frame and sides, and during high water a steamer was floated over the wreck and allowed to subside inside the hull, the wreck was then made secure to the deck of the steamer, and upon the following tide was lifted off the bottom and towed to a higher portion of the shore, where the work of breaking up could be carried on at low water.

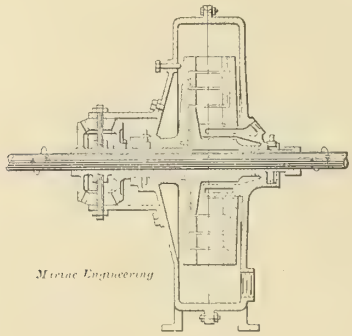
SELECTED MARINE PATENTS.

693,855. APPARATUS FOR PREVENTING COLLISIONS AT SEA. NICHOLAS GHERASSIMOFF, ST. PETERSBURG, RUSSIA.

CLAIM.—The combination with a ship, of a feeler, consisting of an electrically-propelled buoyant body connected with said ship, collision and depth indicating appliances connected with said body, and electrically-operated collision and shoal-water indicator on board ship, controlled by the aforesaid collision and depth indicating appliances, an electric circuit including said appliances and indicator and means for supplying current to the feeler-propeller from aboard ship, for the purpose set forth

2. The combination with a ship, of a feeler, consisting of an electrically-propelled submerged buoyant body, a float connected with said body, an electrically-operated visible signal carried by said float, collision and depth indicating appliances likewise connected with the body, a collision and shoal-water indicator on board ship controlled by said appliances, an electric circuit including said signal, the collision and depth indicating appliances and the collision and shoal-water indicator, and means for supporting current to the feeler-propeller, for the purpose set forth. Twenty claims.

693,946. TURBINE ENGINE. HIRAM H. BOYCE, CHICAGO, ILL.



CLAIM.—1. In a turbine, the combination of a frame; a pair of wheels journaled on a common axis in said frame and revoluble in opposite directions; a series of blade-rings disposed between said wheels and secured alternately to opposite wheels, each of said blade-wheels comprising an annular series of blades disposed at an angle to the radial direction, the blades on one wheel being disposed oppositely to those on the other; one of said wheels having an annular recess on side of same; a hollow ring seated in said recess, secured to said frame and having in its outer periphery an opening through which a stream of fluid may be caused to flow against said blades, thereby causing said wheels to revolve in opposite directions, a considerable portion of the periphery of said ring being without opening so that the supply of fluid will be cut off from each of the blades of the inner series during a considerable part of each revolution. Two claims.

694,153. MEANS FOR AUTOMATICALLY BALLASTING SUBMARINE BOATS.

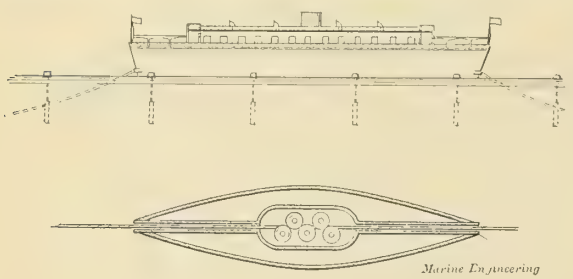
694,154. SUBMARINE BOAT OR VESSEL. JOHN P. HOLLAND, NEWARK, N. J.

694,274. BUOYANT PROPELLER. BERNEDOTT T. HEROLD, VALLEJO, CAL.

694,355. CONVEYING APPARATUS. JAMES G. DELANEY, NEW YORK, N. Y., AND THOMAS S. MILLER, SOUTH ORANGE, N. J.

CLAIM 1.—In combination, two relatively moving supports, a load-carrier, a ropeway whereon said load-carrier is transferred from one support to the other, a tension mechanism tending to hold said ropeway taut and consisting of a float immersed in a fluid. Six claims.

694,433. MEANS FOR GUIDING AND PROPELLING STEAMSHIPS. LOUIS SHER, ATLANTIC CITY, N. J.

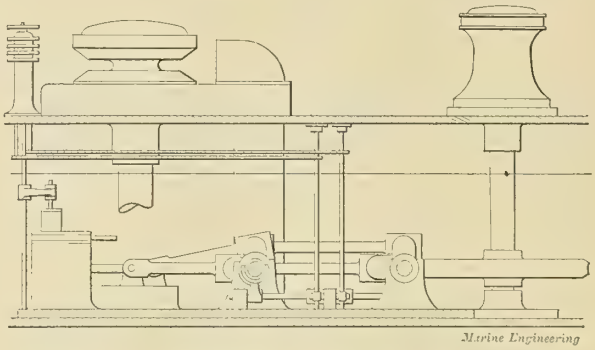


CLAIM 1.—In an apparatus of the character described, a cable extending from one terminus of a steamship-line to the other and secured rigidly to the shore at each end, said cable adapted to pass longitudinally through a vessel and be acted upon by friction-wheels, thereby furnishing a frictional surface for the propulsion of the vessel, a supporting-framework running parallel with the cable from one terminus to the other and lying at a level in the water below the keel of the vessel, buoys connected to said framework at predetermined intervals, anchors connected to said framework at predetermined intervals, substantially as and for the purpose set forth. Three claims.

694,468. RUDDER ATTACHMENT. EUGENE G. GAILLAC, JONESPORT, ME.

CLAIM 1. The combination with the stern of a boat, of a strip countersunk into the stern-post and secured thereto, integral inclined flanges on the sides and lower end of said strip, the latter tapering at its lower end, a bar having inclined sides and lower end and tapering at its lower end, hooks or loops on said bar, brackets bent around said hooks or loops and secured to the sides of the rudder. Two claims.

694,616. MECHANISM FOR OPERATING SHIP WINDLASSES AND CAPSTANS. FREDERICK N. CONNET, PROVIDENCE, R. I.



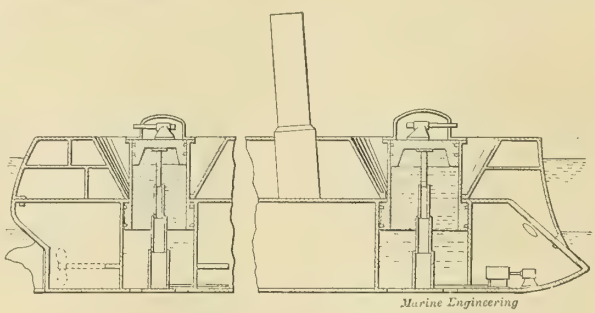
CLAIM 1.—In mechanism for operating ship windlasses and capstans, the combination of two shafts each containing two cranks at right angles to one another, two connecting-rods one between each of the cranks of one shaft and the corresponding crank of the other shaft, means for driving one of the shafts, a clutch between each capstan and windlass and one of the shafts, a standard, a hand-wheel for each clutch upon and surrounding the standard and having an interior gear, a rod for each wheel within the standard, a pinion upon each rod extending through the standard and meshing with the gear of its wheel, and connections between each of the rods and one of the clutches so that the latter may be operated by the rotation of the former. Four claims.

694,643. SUBMARINE BOAT. JOHN P. HOLLAND, NEWARK, N. J.

694,980. ELASTIC-FLUID TURBINE. HERBERT McCORNACK, LITTLE FALLS, N. Y.

695,108. WAR VESSEL. HUDSON MAXIM, LONDON, ENGLAND.

CLAIM 1.—In a vessel the combination of the main hull, a flotation superstructure secured water-tight upon the main hull, ballast-cylinders formed in the main hull and communicating with the open sea, pistons working in said ballast-cylinders, and power devices for operating said pistons, whereby the main hull may be maintained at the sea level or depressed below the same as desired.



2. In a vessel the combination of the main hull provided with a protective deck, a cellular flotation superstructure secured water-tight upon the main hull, fixed ballast-cylinders formed in the main hull and communicating with the open sea, movable cylinders playing in said fixed cylinders and in open communication therewith, weighted pistons playing in said movable cylinders, and a power device controlling the movements of said pistons. Ten claims.

695,215. SUBMARINE BOAT. SIMON LAKE, BRIDGEPORT, CONN.

695,276. MARINE PROPELLER. BURRELL CANNON, PITTSBURG, TEX.

CLAIM 1.—In a propeller or motor-wheel, the centrally pivoted blades, and an eccentric revoluble feathering-wheel arranged to detachably engage the end portions of said blades, and adjustable to vary or reverse the action of said blades, substantially as specified. Fourteen claims.

695,389. PROPELLER-WHEEL. LEANDER W. HAMMOND, PLAINFIELD, N. J., ASSIGNOR OF ONE-HALF TO SAMUEL A. WALLACE, NORTH PLAINFIELD, N. J.

CLAIM.—In a propeller, the combination of a hub coned off at both ends and having diagonal grooves therein, and blades mounted on said hub, substantially as described.